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OLYMPIA EXHIBITION (Twenty-Page Supplement).

The Engineer.

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VOL. CXLIV.—No. 3739] LONDON: FRIDAY EVENING, SEPTEMBER 9, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 2d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—
1. 85ft. ENGINE TURNTABLE.
2. 19 Pairs of WHEELS and AXLES for LOCOMOTIVES.

Tenders due on the 22nd September, 1927, for No. 1, and on the 27th September, 1927, for No. 2.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6459

Assistant Engineers REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 6427

Assistant Engineers Required for the RAILWAY DEPARTMENT of NIGERIA for a tour of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages, liberal leave on full salary. Candidates, aged 23 to 35, should either possess an engineering degree of a recognised University or should have passed Sections "A" and "B" of the Associate Membership examination of the Institution of Civil Engineers. They should also have had 3 or 4 years regular training as a Civil Engineer, preferably on railway works.—Apply at once by letter, stating age, particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15394. 6409

Municipal Engineer Required by the GOVERNMENT of KENYA for service at Mombasa for one tour of 20 to 30 months' service with possible extension. Salary, £840-40-£920 a year. Free quarters and passages, liberal leave on full salary. Candidates, age 30 to 38, must be A.M.I.C.E. or hold equivalent professional qualifications and have had thorough experience of Municipal Engineering and macadam roads.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS for the COLONIES, 4, Millbank, London, S.W. 1, quoting M/15029. 6445

Borough Polytechnic Institute, BOROUGH ROAD, LONDON, S.E. 1.

COMPLETE COURSES, extending over 5 years of evening work, leading to the Ordinary and Higher National Certificates.

ENGINEERING SCIENCE.
PROPERTIES AND STRENGTH OF MATERIALS.
MACHINES AND HYDRAULICS.
HEAT ENGINES.
THEORY OF MACHINE AND MACHINE DESIGN.
STRUCTURAL ENGINEERING DRAWING.
STRUCTURAL STEELWORK DESIGN.
REINFORCED CONCRETE DESIGN.
HEATING AND VENTILATION.
MOTOR CAR ENGINEERING AND DESIGN.
ENGINEERS' QUANTITIES AND ESTIMATING.
PRACTICAL MATHEMATICS.

ENROLMENT 19th, 21st and 22nd Sept., 7 to 9 p.m.

Prospectus will be forwarded on application.

J. W. BISPHAM, Principal.
6333

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Shipping, Engineering and Machinery Exhibition at Olympia (With a Twenty-Page Supplement). THE ENGINEER, 9-9-27.

Condensers for Power Factor Correction No. I. THE ENGINEER, 9-9-27.

British Association—No. II. THE ENGINEER, 9-9-27.

British Steel Trade Bounty Scheme. (J. W. HALL.) THE ENGINEER, 9-9-27.

Institute of Metals—No. I. THE ENGINEER, 9-9-27.

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Electrically Propelled Liner California. THE ENGINEER, 9-9-27.

Grooving Machine for Coned Wheels. THE ENGINEER, 9-9-27.

High Efficiency Centrifugal Pumps. THE ENGINEER, 9-9-27.

SHIPPING, ENGINEERING & MACHINERY EXHIBITION, OLYMPIA, SEPTEMBER 8th-24th.
"THE ENGINEER'S" STAND will be No. 8, ROW G, at which all our Friends will be Welcome.

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PUBLIC NOTICES

City of Cardiff Education COMMITTEE.
THE TECHNICAL COLLEGE.
Principal: CHARLES COLES, B.Sc. (Lond.).
DEPARTMENT OF ENGINEERING.
Head of Department: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.
SESSION 1927-28.
(Commencing on Tuesday, 4th October, 1927.)
The following Courses have been arranged for engineering students:—
A Three Years' Course in Mechanical and Marine Engineering jointly with the University College of South Wales and Monmouthshire.
A Two Years' Course for apprentices and others with facilities for practical experience in the Summer Term.
These Courses are suitable for students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.
Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.
OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually, and candidates for entry to the above Department are eligible to compete.
For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for entrance scholarship examination, duly filled up, must be received before September 17th.
JOHN J. JACKSON,
6317 Director of Education, City Hall, Cardiff.

Crystal Palace School of Practical ENGINEERING.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

PUBLIC NOTICES

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.
FULL-TIME COURSES are provided as follows:
ENGINEERING.
Courses extending four years in Civil, Mechanical, Electrical, Aeronautical, and Radio Engineering and including ten months in the works of industrial firms.
Matriculated students are prepared for internal degree examinations of London University.
OPHTHALMIC OPTICS.
A Course extending over two years and including preparation for the Fellowship Examinations of the British Optical Association and the Spectacle Makers' Company.
HOROLOGY.
ENTRANCE EXAMINATION, OCTOBER 3rd.
Fees from £18 per annum.
For prospectus and further information apply to S. C. LAWS, M.A., M.Sc., Principal.
6356

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for:—
(I.) 3445 TONS STEEL RAILS and 5775 PAIRS FISH-PLATES for B.S. 90/R F.F. Section.
(II.) 5 PETROL TANK WAGONS (4-Wheeled), METRE GAUGE, complete with WHEELS and AXLES.
Tenders are due in on Tuesday, 27th September, 1927, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 6445

PUBLIC NOTICES

UNIVERSITY OF LONDON.
King's College.
FACULTY OF ENGINEERING.
COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.
HEADS OF DEPARTMENTS:
Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).
S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }
Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.
There is a College Hostel and a large Athletic Ground.
For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6073

Northampton Polytechnic INSTITUTE.
St. John Street, London, E.C. 1.
EVENING CLASSES IN ENGINEERING, FUEL TECHNOLOGY, METALLURGY, for ENGINEERS, ENGINEERING CHEMISTS, etc
Commence MONDAY, SEPTEMBER 26th, 1927.
Free Prospectuses may be had on application.
S. C. LAWS, M.A., M.Sc., Principal.
6357

The University of Sheffield.
SESSION 1927-28.
Vice-Chancellor: SIR HENRY HADOW, C.B.E., D.Mus., LL.D.
DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.
The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.
The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.
Part-time Courses are arranged for students who desire to take special portions of any of the regular Courses.
In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' Courses of study at the University and six months' practice at the works or colliery each year for a period of four years. During the first year such students should spend three terms at the University.
The LECTURE COURSES commence OCTOBER 5th, 1927.
The TECHNICAL LABORATORY COURSES commence SEPTEMBER 27th, 1927.
For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates, awarded on their successful completion, application should be made to
W. M. GIBBONS, Registrar.
5917

University of London, King's COLLEGE.
The Delegacy will REQUIRE in October next the SERVICES of an ASSISTANT LECTURER in MECHANICAL ENGINEERING. Salary £300 per annum.—Applications, accompanied by three copies of three recent testimonials, must reach the SECRETARY, King's College, Strand, W.C. 2, from whom particulars and forms of application may be obtained, not later than 16th September. 6305

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PUBLIC NOTICES

Administrative County of LONDON.
BLACKWALL AND ROTHERHITHE TUNNELS.
CLEANING, REPAINTING, &c.

The London County Council invites TENDERS for the CLEANING, REPAINTING, &c., of the METAL-WORK and WOODWORK of the BLACKWALL and ROTHERHITHE TUNNELS, including in each case the Tunnels, Shafts, Approaches, Lodges, &c.

Persons desiring to submit Tenders may obtain the form of Tender and contract, and the specification on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £1 by cheque or draft to the order of the London County Council. This amount will be returnable only if the Tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 26th September, 1927, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
6418 Clerk of the London County Council.

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

1 35-TON ELECTRIC TRAVERSER.
7 ELECTRIC CAPSTANS.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 6th September, 1927.

A fee of 10s. will be charged for each specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Friday, 16th September, 1927.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
E. C. VOLKERS,
Secretary.
6th September, 1927. 6413

New North Bridge, Hull.
TO STRUCTURAL ENGINEERS.

The Corporation are prepared to receive TENDERS for the CONSTRUCTION of a ROLLING BASCULE BRIDGE across and a SUBWAY TUNNEL under the River Hull at a point about 70 yards north of the present North Bridge.

The works include the bascule span of 88ft. 6in. centres, the track girders and cast approach span, cylinder foundations in steel and cast iron, with steel bracing and the cast iron subway and shafts, all making a total weight of structural steel work of about 570 tons, and of cast iron in cylinders and subway tunnel of about 230 tons. The works also include the machinery, motors and control gear for electrical operation of the bridge, the ferro-concrete river walls, west approach span, east and west anchorages, operating houses and culvert for the Foredyke Stream.

Tenders are desired from structural engineering firms, who must Tender for the whole of the work, but may sublet the operating machinery, motors, and control gear, also the concrete and ferro-concrete work above described.

Forms of Tender and other particulars may be obtained at the City Engineer's Office, Guildhall, Hull, on payment of £3 3s., which will be returned to firms submitting a bona fide Tender. Prints of the 19 contract plans may be obtained on payment of £2 10s., not returnable. Remittances must be made payable to Mr. F. Steadman, City Treasurer.

Tenders, endorsed "Tender for New North Bridge," are to be addressed to the Chairman of the Bridges, Old Harbour and Pontoon Sub-Committee, and delivered at the Town Clerk's Office before Noon on Monday, the 26th September.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
T. THOMAS,
City Engineer.
Guildhall, Hull. 6355

HARBOUR OF WATERFORD.
ADVERTISEMENT
FOR THE
CONSTRUCTION OF A DEEP-WATER WHARF
IN THE RIVER SUIR AT WATERFORD.

The Waterford Harbour Commissioners

are prepared to receive TENDERS for the CONSTRUCTION of a DEEP-WATER WHARF or JETTY in the River Suir at Waterford, with relative, connected or contingent work all in accordance with the articles of agreement and the drawings, specification and conditions therein referred to, copies whereof can be obtained on application to the Harbour Engineer, Harbour Office, Waterford, on payment of a fee of Five Guineas, which will be returned in case a bona fide Tender is duly made.

Tenders must be made in the prescribed forms which are attached to the above-mentioned articles, specification and conditions, and must be addressed to "The Chairman," Harbour Office, Waterford, in a sealed cover, endorsed "Wharf Tender," and must be delivered not later than 11.30 o'clock a.m., on Monday, the 17th day of October, 1927.

The date on which the work will be completed must be stated in the Tenders.

Two separate Tenders must be submitted; one based on the original design and the other on the alternative design.

The lowest or any Tender will not necessarily be accepted.

The Harbour Commissioners will not be responsible for any expenses incurred by persons tendering.

Dated the 29th day of August, 1927.

AUSTIN A. FARRELL,
Secretary to the Waterford Harbour Commissioners.
Harbour Office,
Waterford. 6426

The South Indian Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. FOUNDRY COKE.
2. POWER WIRING.
3. CARRIAGE FITTINGS.
4. GALVANISED FENCING PALES.
5. WATER CRANES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Foundry Coke," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 16th September, 1927, for Specification No. 1, and the 23rd September, 1927, for Specification Nos. 2 to 5.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1, 2 and 3, and of 5s. for each copy of Specifications Nos. 4 and 5 Copies of the drawings may be obtained from the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
7th September, 1927. 6457

PUBLIC NOTICES

Skegness Urban District COUNCIL.
WATERWORKS EXTENSIONS.
TO MAKERS OF RECIPROCATING PUMPS.

The Skegness Urban District Council are prepared to receive OFFERS from manufacturers of reciprocating pumps to TENDER for DUPLICATE SETS of CRUDE OIL ENGINES (of about 70 I.H.P. each), WELL PUMPS, RAM PUMPS and ACCESSORIES, to be erected at their Pumping Station at Welton-in-the-Marsh, in the County of Lincolnshire.

Offers to Tender should be addressed by letter to the Consulting Engineer, Mr. Percy Griffith, M. Inst. C.E., F.G.S., 39, Victoria-street, Westminster, S.W. 1, and delivered to him not later than the 16th day of September, 1927.

Form of contract, general conditions, specification of works, form of Tender, and copies of drawing will be sent to a limited number of firms selected from those offering to Tender together with full instructions as to the date and address for delivery of Tenders. The Council do not bind themselves to accept the lowest or any Tender and reserve to themselves the option of selecting any particular make of engine, whether included in the accepted Tender or not.

IVOR M. CULE,
Clerk to the Council.
Council Offices, Skegness,
September 9th, 1927. 6406

Western Australian Government RAILWAYS.
DESIGNING DRAUGHTSMAN WITH EXPERIENCE IN STEEL CAR AND WAGON CONSTRUCTION.

1. APPLICATIONS from qualified DRAUGHTSMEN are INVITED to fill the above POSITION.

2. Applicants must be fully qualified Car and Wagon Designers, and should have had several years' actual experience in the designing of the latest type of Steel Car and Wagon Stock, including workshops practice.

3. Age not to exceed 35 years.

4. Commencing salary £448 per annum, subject to Rules and Regulations of the Western Australian Government Railways and the conditions and privileges of the Departmental Salaried Staff Regulations.

5. The period of engagement will be for three years, with two annual increments of £20 to £488, in accordance with terms of engagement.

6. The successful applicant will require to take up duties at Midland Junction, Western Australia, within four months from date of selection.

7. Second-class fare by mail steamer will be allowed to Western Australia and half-pay on voyage from date of sailing until arrival in Western Australia.

8. Application by letter, accompanied by testimonials and certificate or statutory declaration as to date of birth and nationality, should set forth concisely the technical qualifications, general education, age and experience of applicant, stating whether married or single, and be forwarded to reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2, not later than 30th September, 1927. 6446

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for a Firm in the Midlands Specialising in Flanged Pipe Work, an ASSISTANT to the WORKS MANAGER, who must be capable of supervising production.—Address, stating age, experience, and salary required, 6405, The Engineer Office. 6405 A

WANTED for India for Contract Work, an ASSISTANT CIVIL ENGINEER. Age not more than 25; must have technical qualifications, and experience in Reinforced Concrete Work an advantage. Salary depending on qualifications.—Write, Box N. M., 95, Bishopsgate, E.C. 2. 6353 A

A LARGE MANUFACTURING COMPANY, Whose operations are highly technical, involving many patented processes, is DESIROUS of ADDING to its TECHNICAL STAFF a PATENT SOLICITOR, who will give full time service to the company's patents. Applicants to state age, full record of experience and salary required.—Address, P3600, The Engineer Office. P3600 A

A PATENT AGENT'S TECHNICAL ASSISTANT REQUIRED, having good experience specifications and objections, also fair knowledge trade mark practice. Chemical knowledge desirable, not indispensable.—Details stating salary to Box 624, Reynell's, 44, Chancery-lane, W.C. 2. 6415 A

ASSISTANT and JUNIOR ASSISTANT CIVIL ENGINEER REQUIRED on a large contract near London. The assistant must be thoroughly experienced in setting out, levelling and measuring up for roads and sewers contracts. The junior must be able to use level and will be required to assist generally in office work.—Apply, giving full details of experience, age, and salary required, to Box 4091, c/o Brown's, 39, Tothill-street, Westminster, S.W. 1. 6408 A

DESIGNER for Hydro-electric Plants, with the Best knowledge of modern turbines construction and general lay-out, calculation of piping, apparatus, &c., WANTED for EGYPT, starting from October or November. Agreement for one year, with eventual renewal but without guarantee. Out and homeward expenses shall be separately paid. Apply with references, testimonial and short history of technical education, stating age, conditions and salary wanted. —Applications shall not be entertained if posted after 25th September, to Mr. LELLO PONTECORVO, Consulting Engineer, Corso Italia 7, Milano. 6384 A

ENGINEER SALESMEN (30-35 Years) REQUIRED. Good engineering training essential; preference to men with selling experience with Hydraulic Presses and Rolling Mills or Power Plant, Rolling stock and Structural Engineering. Fullest particulars of qualifications, experience, knowledge of German and salary.—Address, 6458, The Engineer Office. 6458 A

GENTLEMAN Correspondent Typist for French and English technical hydro-electric languages WANTED for EGYPT. Agreement one year, travel expenses Egypt and back reimbursed. Apply with references, testimonial, speed of writing on typewriter and short history of education, stating age, conditions and salary wanted.—Applications shall not be entertained if posted later than 25th September to Mr. LELLO PONTECORVO, Consulting Engineer, Corso Italia No. 7, Milano. 6385 A

IMPORTANT COMMERCIAL AUTOMOBILE COMPANY in the Midlands has VACANCIES for well-educated YOUNG MEN of good address, between the ages of 18-23, to undergo practical shop training to fit themselves for appointments overseas as Demonstrators and Service Representatives. Some engineering or technical experience an advantage.—Address, with full particulars of education, technical and commercial qualifications, references, &c., 6455, The Engineer Office. 6455 A

METALLURGIST REQUIRED, to Take Charge of Laboratory and Heat Treatment Dept. of Engineering Works near London, engaged on manufacture of Aero engines and high-class general work. Qualifications and salary required.—Address, 6377, The Engineer Office. 6377 A

WORKS MANAGER REQUIRED for Small Engineering Works, London area, to organise accurate rapid production of light and medium work on repetition lines, but not in large numbers. Experience on instrument work desirable. Energy, tact, and capacity for hard work essential.—Address, giving record of education and experience, stating age and salary, to 6440, The Engineer Office. 6440 A

WORKS MANAGER, with Successful Experience in the design and manufacture on the most economical and up-to-date lines of Oil Engines, Compressors and similar Engineering Products, REQUIRED by well-known North British firm. Must be first-class production organiser.—Address, giving full details of training, experience, age and salary, to 6435, The Engineer Office. 6435 A

SITUATIONS OPEN (continued)

REINFORCED CONCRETE DESIGNER REQUIRED, with specialist training and experience in all classes of Reinforced Concrete Structures.—Applications, stating age, experience, and salary required, to THE B.R.C. ENG. CO., Ltd., Stafford. 6418 A

WANTED, EXPERIENCED DRAUGHTSMAN; capable of designing and estimating for Bridge and Structural Steelwork.—Address, stating experience and salary required, 6361, The Engineer Office. 6361 A

WANTED, FIRST-CLASS DRAUGHTSMAN, with considerable experience of General Arrangement Drawings and Steam Plant Layouts. Write, stating age, salary, experience, with copies of testimonials.—Address, 6420, The Engineer Office. 6420 A

WANTED, First-class MECHANICAL DRAUGHTSMAN, with experience in Concrete-mixing Machinery. — State age, qualifications and salary required, to RANSOMES and RAPIER, Ltd., Waterside Works, Ipswich. 6456 A

WANTED for London Drawing-office, an ENGINEERING DRAUGHTSMAN, one with experience in Structural Steelwork preferred.—Address, stating age, experience, and salary required, to 6425, The Engineer Office. 6425 A

WANTED IMMEDIATELY, DRAUGHTSMAN, Preferably with experience in Crushing and Quarrying Plant.—Apply, stating age, experience, and salary required, to SAMUEL WILLIAMS and SONS, Limited, Dagenham Dock, Essex. 6448 A

WANTED, JIG and TOOL DRAUGHTSMEN.—Write, stating age, experience and wage required, to COMMER CARS, Ltd., Luton. 6437 A

ASSISTANT STRUCTURAL DRAUGHTSMAN REQUIRED by a Municipal Corporation, at a salary of £30 per month. The appointment will be temporary, and subject to one month's notice on either side. Candidates must be good draughtsman, capable of designing and carrying out Steel Constructional Works and of preparing detailed plans, specifications and quantities. Preference will be given to applicants having experience in Pier Construction.—Address, stating age, qualifications, experience and references, to 6434, The Engineer Office. 6434 A

CHIEF DRAUGHTSMAN WANTED by a Firm of General Engineers in the Manchester district. Competent to take executive charge of a drawing-office with a staff of 30 to 40. Must be good organiser and disciplinarian with ability to get work out quickly and efficiently. Experience in the design of Uniflow Engines, Winding Engines or large Condensing Plant an advantage.—Address, stating age, full particulars of experience, and salary required, 6394, The Engineer Office. 6394 A

CHIEF DRAUGHTSMAN WANTED for Large Marine Engineering Establishment in North of England employing about 50 draughtsmen. Applicants must have good experience in Reciprocating, Turbine and Diesel Engines for both naval and merchant work.—Address, 6403, The Engineer Office. 6403 A

DRAUGHTSMAN.
APPLICATIONS are INVITED for the POSITION of a DRAUGHTSMAN on the staff of the Resident Engineer for a large Dock Construction Contract.
Applicants must be good draughtsmen, experienced in keeping progress plans and measuring up work, checking of setting out, levelling, &c.
Applications, giving age, qualifications, experience, and stating salary required, must be accompanied by copies of two recent testimonials and addressed to Box F.O. 3439, Willing's, 20, King-street, W.C. 2. 6407 A

DRAUGHTSMEN, ONE or TWO, WANTED AT ONCE for London. Good structural and mechanical engineering experience essential, making own tracings, quick and neat on structural work. Applicants should state age, experience, wages required, and when at liberty.—Address, P3598, The Engineer Office. P3598 A

DRAUGHTSMAN REQUIRED for East Midlands; one accustomed to Engine and Boiler Design. Knowledge of structural work an advantage. Write, stating age, training, experience, salary, and date free.—Address, 6422, The Engineer Office. 6422 A

DRAUGHTSMAN REQUIRED for London Office. Must be fully experienced in Proposal Work for Conveyor Plants, Transporters, Telphers, Hoists, &c. —Address, stating age, experience and salary required, P3614, The Engineer Office. P3614 A

GOOD STEEL CAR BODY DRAUGHTSMAN REQUIRED. State experience and salary required.—UNION CONSTRUCTION CO., Feltham, Middx. 6460 A

REQUIRED, First-class AERONAUTICAL DRAUGHTSMEN, with full knowledge of the requirements of Aircraft Design. Only men with sound experience need apply. State full experience and salary required.—Address, 6324, The Engineer Office. 6324 A

SMART, METHODICAL DRAUGHTSMEN REQUIRED in S.W. London, preferably with experience in Dairy, Brewery, or Chemical Work. Permanency with good prospects to reliable applicants. State age, experience, and salary required.—Address, P3595, The Engineer Office. P3595 A

TOOL DRAUGHTSMAN, Aged about 30, REQUIRED by Manufacturers of High-grade Machine Units, 30 miles from London. Press tool experience preferred. Good prospects of advancement if satisfactory.—Address, 6423, The Engineer Office. 6423 A

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REQUIRED for a Constructional Steel Works in London employing 150/200 men, a First-class FOREMAN, about 35/40 years of age. Must be thoroughly capable in all branches of the work, strict disciplinarian, able to control workmen, and should have held similar position.—Address in first instance in writing, giving full particulars of experience, salary required, and when free, P3596, The Engineer Office. P3596 A

TWO FITTERS REQUIRED for Erection on Site of Heavy Pumping Machinery and Engines. Give full particulars, including age, wage, and class of plants previously engaged upon.—Address, 6462, The Engineer Office. 6462 A

SITUATIONS WANTED

A COMMERCIAL ENGINEER, (36), A.M.I.C.E., A.M.I.M.E., workshop, design, inspection and sales experience with power plant and machinery, REQUIRES POSITION as Sales Manager or Representative. Excellent business record. — Address, P3594, The Engineer Office. P3594

AS RESIDENT ENGINEER on Heavy Bridge, Dock or Railway Work. Highest references.—Address, 6442, The Engineer Office. 6442 B

CIVIL ENGINEER (34), Fully Qualified, Experienced at home and abroad, highest references, SEEKS COMMERCIAL POST where engineering knowledge useful.—Address, P3613, The Engineer Office. P3613 B

CRANE ENGINEER, M.I. Mech. E. Over 30 Years' sound experience in Design, Manufacture and Sale of all Types, also Works and Office organisation, SEEKS POSITION as CHIEF ENGINEER, at home or in Dominions.—Address, 6342, The Engineer Office. 6342 B

SITUATIONS WANTED (continued)

CHARTERED CIVIL ENGINEER, Long Experience public works (inside and out), home and abroad, special knowledge reinforced concrete construction, used to full control, OPEN for RESPONSIBLE POSITION at home or abroad.—Address, P3619, The Engineer Office. P3619 B

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ENGINEER (47), 25 Years' Experience inc. America, repetition work, up-to-date methods, also selling experience, 10 years works manager, SEEKS RESPONSIBLE POST inside or outside.—Address, P3609, The Engineer Office. P3609 B

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EXPERT ICE and COLD STORAGE ENGINEER, returning to England, DESIRES POSITION. 41 years New York State as chief engineer large steam and electrically driven plants, 12 years engineer on largest Atlantic line, 1st Class B.O.T. Certificate, experienced in handling men; results assured.—Address, G. P. R., 22, St. Elmo-road, Wallasey Ches. P3602 B

LANCASHIRE MAN, A.M. Inst. C.E., A.M.I.E.E., Hons. Mech. Eng., experience public works, power station plant, industrial machinery, R.C. construction and general buildings, OPEN to ACT as ENGINEER, AGENT or REPRESENTATIVE for firm of repute, whole or part time.—Address, P3603, The Engineer Office. P3603 B

MECHANICAL ENGINEER, Age 25, 5 Years' apprenticeship firm of general engineers, 3 years' experience installation and maintenance of crude oil engines and factory plant, DESIRES POSITION which offers prospects to a keen worker with view to SUBSEQUENT INVESTMENT.—Address, P3608, The Engineer Office. P3608 B

MECH. ENGINEER (41), Bachelor, Public School, college, works, D.O., home and Indian rail loco. exp., 12 years East Africa, erection, running, steel buildings, steam, gas, oil engines, cotton and hydraulic mach. management, cotton ginning business, highest refs., DESIRES RESPONSIBLE APPOINTMENT abroad.—Address, P3597, The Engineer Office. P3597 B

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DRAUGHTSMAN (Age 23) DESIRES CHANGE; 7 years' experience Roots blowers and general engineering.—Address, P3620, The Engineer Office. P3620 B

DRAUGHTSMAN, 20 Years' Experience, General engineering, factory lay-outs, conveyors and elevators, rubber and chemical plant, pipe work lay-outs and details.—Address, P3612, The Engineer Office. P3612 B

JUNIOR DRAUGHTSMAN (22), 4 Years Regent-street Polytechnic, Poly. diploma, 2 years workshops, 1 year drawing-office, DESIRES POST: disengaged.—M., 108, Sheen-road, Richmond. P3611 B

MECHANICAL DRAUGHTSMAN (39) SEEKS SITUATION in London area; 15 years' experience, 3 years jig and tools, 7 years with Vickers.—Address, W., 80, Tunstall-road, Croydon. P3617 B

POST with Boiler Co. REQUIRED as SALES ENGINEER or CHIEF DRAUGHTSMAN; 16 years' specialised experience in lay-outs for coal, oil, gas, and waste heat-fired boilers, water-tube, fire-tube, and Lancashire types.—Address, P3599, The Engineer Office. P3599 B

FOREMAN, Auto. Screw Making Machines, DESIRES similar POSITION or VIEWER (age 43); 26 yrs. practical experience, 18 yrs. responsible position.—Address, P3601, The Engineer Office. P3601 B

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THE FINANCIAL SUPPORT of a PUMP MANUFACTURING FIRM or others is invited to BUILD and TEST a NOVEL APPLICATION of the GAS DISPLACEMENT PUMP (Humphrey Type). The cycle is two stroke, but avoids all previous disadvantages of this system. £200 is available for an experimental plant, which is estimated to cost £480 bare. The use of the plant is purely low lift heavy volume work. Egypt, India, Irak suggest three useful centres of utility. British patents alone.
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MACHINERY, &c., WANTED

WANTED, GRANULATING MACHINERY to reduce slag from 2½in. to chippings, quantity about 10 tons per hour. Rolls or other suitable machines.—JOHN F. WAKE, Darlington. 6367 F

WANTED, HYDRAULIC PRESS for Boiler End Plates for flanging in sections, accumulator pressure 1600.—Address, 6443, The Engineer Office. 6443 F

WANTED, SECOND-HAND Single-cylinder Four-stroke DIESEL ENGINE, 40 to 80 H.P.; must be complete with all accessories and in good running order. State price and full particulars.—Address, 6404, The Engineer Office. 6404 F

SURVEYING AND LEVELLING.—Thorough Practical INSTRUCTION given by an EXPERT, late S.P.D. and L.S.W. Rlys.—Apply, E. MOUL, Hollybank, Woking. P3604 E

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Retirement of Sir Vincent Caillard.

ON Thursday of last week Sir Vincent H. P. Caillard resigned from his position as director of Vickers Ltd., a post which he has held for the past twenty-seven years. Sir Vincent was mainly responsible in arranging for the recent reconstruction of the company in accordance with the scheme proposed by Mr. Dudley Docker, Mr. Reginald McKenna and Sir William Plender. The financial and administrative reorganisation is now practically completed, and Sir Vincent, having seen it through, has now retired to the great regret of his colleagues. He was born in 1856, and was educated at Eton and the Royal Military Academy, Woolwich. He received a commission in the Royal Engineers in 1875, and from that date until 1898 he acted in various military and political capacities in the Balkans, Near East and Egypt. In 1898 he resigned his post as financial representative for Great Britain, Holland and Belgium at Constantinople, and joined the board of Vickers, Son and Maxim. In 1906 he was appointed financial director of the company. Outside his connection with Vickers, Sir Vincent took an active part in Mr. Joseph Chamberlain's Imperial fiscal campaign. A book which he wrote, "Imperial Fiscal Reform," became a well-known treatise on the subject in its earlier days. In 1904 he was appointed chairman of the Tariff Commission, and in 1920 he became its President. In 1919 he was elected President of the Federation of British Industries. He is a director of the Southern Railway and of several other companies and corporations. Engineer, soldier, politician and financier, it remains to be added that he has a strong leaning towards literature and music. He has published various essays, reviews, articles and stories, and has composed various songs, including a musical setting of Blake's "Songs of Innocence." In succession to Sir Vincent Caillard, Sir Mark Webster Jenkinson has, we learn, been appointed financial controller to the company. Sir Mark is already a director of Messrs. Vickers, and as an accountant conducted an investigation into the company's position on behalf of Mr. Docker, Mr. McKenna, and Sir William Plender as a preliminary to their report. He was Controller of Factory and Audit Costs at the Ministry of Munitions from 1915 to 1918, and after the War served as Chief Liquidator of Contracts. He has been vice-chairman for some time of Vickers' Finance Management Board.

New Motor Oil Tankers.

THE first of a series of new oil tankers which are to be propelled by oil engines and which were ordered last year by the British Tanker Company, Ltd., of London, was launched last week at the Port-Glasgow Yard of Lithgows, Ltd. The British Valour is a 440ft. ship with a beam of 57ft. and a depth of 33ft. 11in. She has a designed deadweight carrying capacity of over 10,000 tons, and her tank arrangement includes twenty main tanks and ten summer tanks. The hull has been constructed on the Isherwood longitudinal framing system. John G. Kincaid and Co., Ltd., of Greenock, are supplying the propelling machinery, which will consist of an eight-cylinder single-acting four-stroke marine oil engine of the Kincaid-Harland long-stroke type with cylinders of 740 mm. bore and 1500 mm. stroke. It is designed for an output of 2700 S.H.P. at a normal speed of 98 r.p.m. The designed speed of the ship on trial will be 11½ knots. Some of the auxiliaries, including the Hele-Shaw steering gear and the CO_2 refrigerating plant, will be electrically driven, but steam-driven oil cargo pumps will be used and the steam will be raised in two Scotch marine boilers, one of which will be arranged to utilise the exhaust gases from the main engine. At the luncheon which followed the launch it was stated that, although the building of the ship had been delayed nine months by the coal dispute, the builders had made up four months of the leeway. Tanker tonnage forms an important item in the orders recently booked on both the Clyde and the Tyne. At the yard of the Furness Shipbuilding Company, Ltd., at Havertonhill-on-Tees, five large oil tankers are in hand. The most recent order is one for a 10,000-ton 540ft. oil tanker for the Imperial Oil Company, of Toronto, in which twin sets of six-cylinder Krupp oil engines are to be fitted.

The British Steel Rebate Scheme.

THE scheme under which the heavy steel manufacturers of Great Britain are prepared to grant rebates of from 5s. to 7s. 6d.—in certain cases up to 12s. 6d.—per ton to British consumers of plates, sections, and joists who undertake not to purchase any similar competing foreign material, has, since it was announced a week or so ago, attracted considerable attention and excited a certain amount of criticism. Attention has been called to the fact that this year's estimated imports of plates, sections and joists, the three categories to which the rebates are applicable, will, if they continue at the present level, represent a value of about £8,000,000. The total value of all the iron and steel imported into this country during the year is estimated by the steel makers, if the flow is unchecked, to reach about £50,000,000. It follows, therefore, that the rebate scheme, even if completely successful, cannot possibly affect more than some 25 per cent. of the inflow of foreign material. It has also been pointed out that the rebates will still leave the prices of home plates, sections and joists about 20s. per ton above the present foreign prices. Emphasis has also been placed by Mr. Skelton on the fact that the British consumer does not buy foreign steel for the sake of obtaining extra profit, but because he himself is a manufacturer and has to buy in the cheapest market if he is to compete against his foreign rivals. The economic pressure in this respect is so great that the heavy steel manufacturers are themselves forced to import large quantities of foreign steel in the form of ingots, sheet bars, billets, &c. The unsatisfactory condition of the British steel industry in the opinion of Mr. Skelton is attributable to the facts that a substantial portion of our iron and steel works is economically unfit to survive, that our productive capacity stimulated by the demand for munitions is excessive, and that the iron and steel workers' standard of living is above that of the corresponding workers on the Continent.

The Naval Construction Programme.

HAVING regard to the negative result of the Geneva Naval Conference, it is reasonable to assume that the five-year shipbuilding programme which Parliament approved in 1925 will now be carried out in full. This programme embraces, *inter alia*, sixteen cruisers, only seven of which have been ordered so far, viz., four in 1925 and three last year. Three more cruisers, one of 10,000 and two of 8000 tons, are due to be ordered in the present financial year, besides a flotilla leader, eight destroyers and six submarines. It was no doubt expedient to defer the placing of new naval contracts pending the outcome of the proceedings at Geneva. The British Government, indeed, as an earnest of its good faith, offered to suspend the construction of H.M.S. Dorsetshire, one of the cruisers orders last year, and upon which a considerable sum of money had been already spent. But with the palpable failure of the Conference there is no object in retarding further the methodical execution of the programme, and it is to be hoped therefore that the contracts for this year's group of vessels will be awarded without avoidable delay. The prospects for our shipbuilding industry during the coming winter would be materially brightened if the outstanding Admiralty orders were placed at an early date. It is in any case clear that no useful purpose of a political nature would be served by delaying or modifying the programme of naval construction. Abroad, the building of cruisers and smaller naval craft goes forward steadily, and it will not have escaped notice that the United States Government has recently ordered six new cruisers of the heaviest type to be laid down.

The Late Mr. William Stewart.

THE death occurred on Saturday last of Mr. William Stewart, of Brodawel, Caerleon, Newport, who was one of the foremost mining engineers in South Wales. Mr. Stewart was seventy years of age and was a native of Dalhousie, near Edinburgh. He served his articles to the late Mr. Archibald Hood, the proprietor of the White Hill and Dalhousie Collieries. In 1876 he went to South Wales as the chief surveyor at Mr. Hood's Rhondda Valley Collieries and later was appointed manager of one of the Glamorgan Coal Company's collieries at Penrhiwfer, Ely Vale. Nine years later he took over the management of Harris's Navigation Collieries at Treharris, now owned by the Ocean Company, and in 1893 he accepted the management of the Powell Tillery Steam Coal Collieries, Abertillery, from which position he succeeded to the post of agent and ultimately to that of managing director. In 1916 he retired from active work, but continued as the company's representative on the Coalowners' Association, of which he was an ex-chairman. Mr. Stewart was also an ex-President of the South Wales Institute of Engineers and played a leading part in the formation of the South Wales and Monmouthshire Colliery Officials' Association. He will always be remembered for his gallant rescue work at mining disasters in South Wales, notably at the fire at Dinas in 1879, when sixty-three lives were lost; at Pen-y-Graig in 1880, when eighty-four lives were lost; and at the Great Western Collieries, Pontypridd, in 1894, when he nearly sacrificed his own life in his endeavour to reach the eighty miners who were entombed.

Another Atlantic Flight Tragedy.

THERE can now be little or no hope left that Colonel Minchin, Captain Hamilton and Princess Löwenstein-Wertheim, who left Upavon on Wednesday of last week, August 31st, on a Fokker monoplane to fly to Ottawa have perished in their daring attempt. Several reports have been received of the machine or its lights having been seen by steamers crossing the Atlantic, and one at least suggests the possibility that it succeeded in reaching some point near the Canadian coast; but with the passage of time and the absence of definite news, it has become more and more likely that these British fliers have met a fate similar to that which overtook the Frenchmen Nungesser and Coli in June and St. Roman and Mouneyres in May. These three attempts to fly the Atlantic from east to west have failed, and by their failure have done much to lower the good public impression produced by the several successful flights which have now been performed in the reverse direction. Indeed, many people are of the opinion that the harm done to the progress of aviation by these repeated tragedies is much greater than the benefit accruing from the successful performances. Yet at the moment of writing several other aspirants to fame are waiting, on both sides of the Atlantic, a favourable opportunity for the essay of a performance from which they can hope to emerge with their lives only with the extreme of good luck.

The Scapa Flow Salvage Operations.

DURING last week the upturned ex-German battle-cruiser Molkte, which was floated by Cox and Danks, Ltd., and beached on the island of Cava in Scapa Flow in June last, was successfully towed 3 miles to a position within 400 yards of Lyness Pier. She is now in a sheltered position, and at high tide on Tuesday of next week it is hoped to bring the hull still nearer the pier. In order to tow the 23,000-ton ship all apertures were again made water-tight and air pressure was applied inside the ship until she became partially buoyant. Before leaving Cava the propellers were removed from the ship and several hundreds of tons of plating were also taken away with a view to lightening the vessel for the towing operations. Floating docks were attached, one at either side of the ship, and tugs were arranged both fore and aft. At first the work was hampered by heavy weather, but early last week advantage was taken of a fine day to accomplish the towing operations. We believe that the towing of an upturned battleship over a distance of 3 miles represents a feat which is unparalleled in the history of marine salvage operations. In addition to working on the Moltke, the firm is also engaged in salving the Seydlitz, which is now lying on her side in a position not far from the submerged Hindenburg.

A New 25,000-Ton Floating Dock for France.

THERE has recently been delivered and moored at Puillac, Bordeaux, a new 25,000-ton floating dry dock, which has been constructed at Hamburg and built under the Dawes reparation scheme by the Vulcan Company to the order of the Bordeaux port authorities. The dock is of the Klitzing self-docking type and has the following principal dimensions:—Overall length, 220 m.; length over pontoons, 206·08 m.; overall breadth, 42·34 m.; available breadth, 34 m.; height, 4·71 m. The dock can be submerged to accommodate ships with a draught of 8·80 m. Its total lifting capacity is 25,000 tons and there is a large centre section with two smaller end sections, which can be easily removed one from the other for self-docking purposes. Welding has been employed in the construction of the keel blocks and bilge wedges. Complete compressed air and electric power and lighting equipment is provided for repairing work, and the dock has its own electric power station, in which four 260 B.H.P. oil engine-driven electric generator sets are installed. The engines are of the M.A.N. four-stroke airless injection type. The equipment includes four 5-ton capstans and two 5-ton electric travelling jib cranes, which are arranged to travel along the walls of the dock. The pumping plant has been designed to deal with 25,000 tons of water within a space of two hours. There is no doubt that the new dock will prove to be a very useful addition to the port facilities, especially for large passenger ships in the North and South Atlantic service.

Noise in the Manchester Streets.

ON Wednesday last, September 7th, the Manchester City Council considered a report of its Streets and Paving Committee on the question of reconstructing the road surfaces of the streets of Manchester in such a manner as will make them less noisy. The opinion was expressed that in a city of Manchester's importance a smoother and more noiseless pavement than that at present used might with advantage be employed. It is recognised that, although the cost of such a road surface might be somewhat higher than that for ordinary setts, yet in the streets of the residential districts, as well as of the business and shopping centres of the city, some material giving a quieter and more sanitary surface than setts is required. Some experiments have already been carried out with wooden blocks and composition setts with varying results, but rock asphalt has been found on the whole to be more effective in lessening noise. Even though the noise caused by the surface of a road be eliminated, some co-operation with the police will be necessary if the greatest possible quietness is to be achieved. It is suggested that more care should be taken by motorists in the matter of the sounding of motor horns, while such improvements as shutting off the engines of standing vehicles and the use of more effective silencers for motor cycles would secure a very desirable decrease of noise without loss to anyone.

An American Diary.

No. VII.*

WASHINGTON.

OUTSIDE their own ranks we are not sure that any one in America likes politicians. We heard very few good words said about them and many bad ones. Even in the centre of Government it is said that were it not for politics and politicians Washington would be a fine city. We were, then, fortunate perchance in that we did not meet a single member of either House during our short stay, for we have nothing left but admiration for what is indeed to the visitor a very beautiful city. The savour of its tree-shaded streets, its numerous little green squares, its quiet urban and suburban "homes," and its air of cleanliness and quiet after the clash and hurry of New York and Philadelphia is still with us. We entered other pleasant enough cities in the United States, Boston, Newhaven and Hartford stand out in our minds, but they lacked the combination of grandeur and repose, and a certain air of dignified leisure which permeates the political centre of America. Is it indeed a whited sepulchre ?

We have called ourselves fortunate in that no politicians crossed our path. But to that we must make one exception. It was with real regret that we were unable to make the acquaintance of Mr. Hoover, who was called away at the time of our visit to the crisis in the Mississippi Valley. But Mr. Hoover is, like Mr. Baldwin, an engineer, and that makes a difference. Besides, did not he do "Agricola" into English, and produce it in a style which satisfies, in some measure, those who can never hope to possess an original copy ?

BUREAU OF STANDARDS.

One does not go to Washington to see power stations but to see the laboratories for which the city is famous, and particularly those of the Bureau of Standards. A whole day was spent in them, a Saturday, and long after working hours, so long indeed that dinner time was nearly past before we got back to the city, Dr. Tuckerman was showing us their astounding resources. A tireless man of infinite patience and courtesy and knowledge who excused his zeal and his gross overtime on the plea that we were interested. But who could fail to be interested when each successive door, in a veritable beehive of cells, opened to reveal some new research on a large scale. It is a little difficult to give a conception of it, and any one who has attempted to absorb so large a place in a few crowded hours will forgive us if our memory of details is obscure. Here, besides the physical, engineering and other laboratories, is a complete paper mill, a large weaving shed, with looms and spinning frames, a glass works where all the optical glass for the Government is made, a large leather department and a department where rubber is manufactured and investigated. We are conscious that we only saw a fraction of the whole, that there are buildings which we never entered and laboratories that we never peeped into, but the impression left upon us is that of an establishment which has endless money and endless resources in men and materials.

The first part of our visit was spent with Dr. Briggs, who is in charge of the new apparatus with which a complete reinvestigation of the properties of steam is to be made for the American Society of Mechanical Engineers. The essential feature of this apparatus is, of course, the calorimeter upon which a vast amount of time and patience and an equal amount of money has been spent.

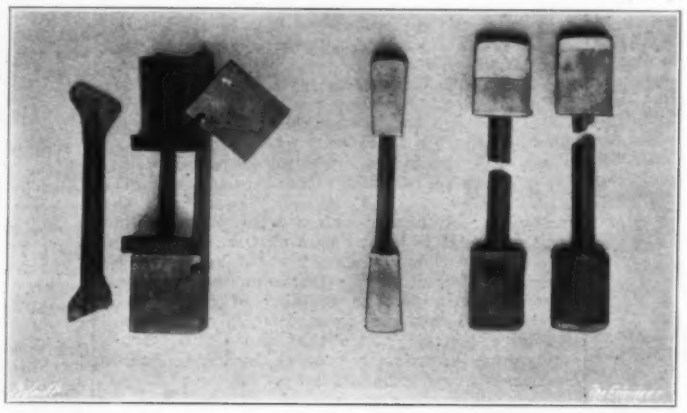
A rough idea may be given in a few words of the construction of this calorimeter. It consists of an inner pot in which the actual heat transfer is effected. This pot is supported inside a larger one from which it is insulated by a vacuum. But whilst a vacuum may arrest convection, by removing the medium through which it takes place, it cannot stop radiation. To correct that loss the outer pot is heated just enough to return to the inner pot the amount of heat which it radiates. It is a delicate matter to secure the right balance, to make sure, indeed, that no heat is passing out of the inner pot or into it ; but by using electrical pyrometers at all the vital points and connecting them to a Wheatstone bridge it is believed that the desired object has been attained.

The calorimeter proper—that is to say, the inner pot—is provided with fine tubes of a material with low heat conductivity, through which water can be introduced. At the bottom of the calorimeter there is an exquisite little centrifugal pump on a vertical spindle, which is driven by a remote electric motor. This pump keeps all the water in circulation, but part of it it picks up and drives through *ad hoc* passages on to a heating coil. No part of the apparatus has given more trouble than the design of this coil, which is now a beautiful production. It is about 3in. in diameter by about 2¼in. long, and is made of a "ribbon" wound in a helix to form a close cylinder. The ribbon is composed of a resistance wire buried in refractory material and then covered with fine wire gauze. The amount of heat given to the water is measured electrically. In use the method of differences is employed. To begin with, the calorimeter is filled about three parts full. An observation is made and some of the water is drawn off and weighed. The observations are then repeated with the remaining water. So far only preliminary low temperature measurements have been made and the full programme has, we believe, not yet been settled. It is the hope of the A.S.M.E. that such accurate results may be secured that steam tables can be settled once and for all.

To attempt to deal, even by name, with all that we were shown in the laboratories of the Bureau of Standards is out of all question. We must ask those who are patient enough to read this Diary in the hope of finding something useful in it—as one turns over a scrap heap, putting to one side little odds and ends—to be satisfied with sketches of a few things which particularly attracted our attention, little things in their way, but of general utility. Take first, for example, the very ingenious auto-collimator which Dr. Tuckerman has devised and which some day, not very far distant, we may see "upon the market." Its use may be considered in connection with an extensometer. Imagine a small rectangular bar of steel about 2½in. long. Across it near one end there is permanently attached a knife edge. At the other end, on the same face, is a tiny incision or notch exactly 2in. from the knife edge. Imagine, further, a small bar of stellite one-tenth of an inch square and with part of one face highly polished. These are the essential parts of the extensometer. Two very tiny notches are made, 2in. apart, in the test piece. With one of these notches the knife edge engages. In the other one corner of the little stellite bar, or "lozenge," to give it its proper name, is placed, whilst the opposite corner enters the notch in the main bar. This simple appliance is attached to the test piece with a couple of rubber bands. It is plain that any lengthening of the test piece will cause the lozenge to rock, and if the amount of rocking can be measured the extension will be known. Hitherto the practice has been to use a rigidly fixed lamp to throw a beam of light on to the mirror fashioned on the lozenge, which returned it to a rigidly fixed telescope provided with a scale. Dr. Tuckerman's collimator overcomes the objections to and difficulties inherent in that plan. The lamp and the telescope with its scale or graticule form a single unit, which may be hung freely from any convenient support. The little electric bulb throws its beam upon the mirror, which returns it through the graticule in the eye piece. Independent external adjustment is not needed ; the whole thing is self-contained, and although the arrangement of the parts has called for a deal of ingenuity, the instrument, when seen in the commercial form which it is now taking, is delightfully simple and workable and its sensitiveness is of the highest order.

It reminds us of a device for the same kind of purpose developed by the United States Navy for measuring the deflections of airship members. In that case a longer bar is used and is attached to the part to be investigated. Coupled to the bar is a little pile of carbon resistance-buttons—not unlike those that Edison devised years ago for use with his Tasimeter. Bending of the bar will cause compression of the buttons and alter their electric resistance. The merit of this device is that any number may be fixed at convenient places, whilst all the leads may be brought back to a single station.

The Bureau was busy with the tests of duralumin parts for airships at the time of our visit. Numbers of the little aluminium alloy stay which is shown to the extreme left of the engraving below have to be tested in extension, and the problem arose, first, how to hold them at all, and, secondly, how to make sure that the pull was truly axial. The first problem has been solved by the use of Wood's metal, which, as everybody knows, is an alloy that melts at a temperature of 200 deg. Fah. or less. The ends of the stays are sand blasted to give them a matt surface ; they are then fixed in a mould and lumps of Wood's metal are cast on the ends. The metal grips tight—it will even hold a straight piece—and slipping very rarely occurs. The temperature at which the Wood's metal melts is far too low to have any effect upon the nature of the alloy.



ALUMINIUM STAY, MOULD, AND TEST PIECES WITH WOOD'S METAL HEADS CAST ON

So much for the first part of the problem. Now for the second part—to design grips which will ensure true axial loading. How this end has been achieved is shown by the two illustrations on page 273. It will be seen that the cast-on heads of the specimen are secured in boxes. On opposite sides of each box are two pins upon which two links hinge freely. The other ends of these links are hinged to a floating plate which in its turn is provided, on the other faces, with two pairs of links which are hinged to the crosshead. It will be observed that the two links of any pair are not parallel. As a matter of fact, all the links are so inclined towards each other that their centre lines would meet in a plane just at the exposed end of the specimen. We leave our readers to work out the geometry of this very ingenious device.

In our notebook we find a sketch with a query mark to it. It was added subsequently when we were not sure whether we had seen the device at the Bureau of Standards or in one of the several other laboratories which we visited. However, even though we may attribute it wrongly, it is too interesting to leave out. The object is to test refractory materials. A familiar way, as everyone knows, is to expose the material in the oven with standard "cones" which fall to pieces at ascertained temperatures. The device we have in mind is more simple, more accurate, we are told, and more rapid. The refractory material is made up into a little flat slab, of which the sides are rounded like a gouge-slip. This specimen is set up on its side in a box and over its upper rounded edge is stretched a ribbon of platinum. The platinum is heated by an electric current and its temperature is found by an optical pyrometer passing through the top of the box. If the refractory fuses the platinum adheres to it. What could be simpler ?

Here we must leave the laboratories with a word of thanks to all who answered our interminable questions, and particularly to Dr. Tuckerman, who, not content with devoting his whole Saturday afternoon and more to us, gave us an American dinner at his club, and would have taken us to a meeting of a Physical Society had we not felt that it was more important to study the social customs of the Americans—in a theatre.

FIXED NITROGEN RESEARCH.

There is another laboratory in Washington that is well worth a visit, if only for the pleasure of chatting with Dr. Cottrell ; but it is best to meet him in the heart of the city and to get him to drive you out through the leafy streets, and along the great roads, past the noble Gothic Cathedral,

* No. VI. appeared September 2nd.

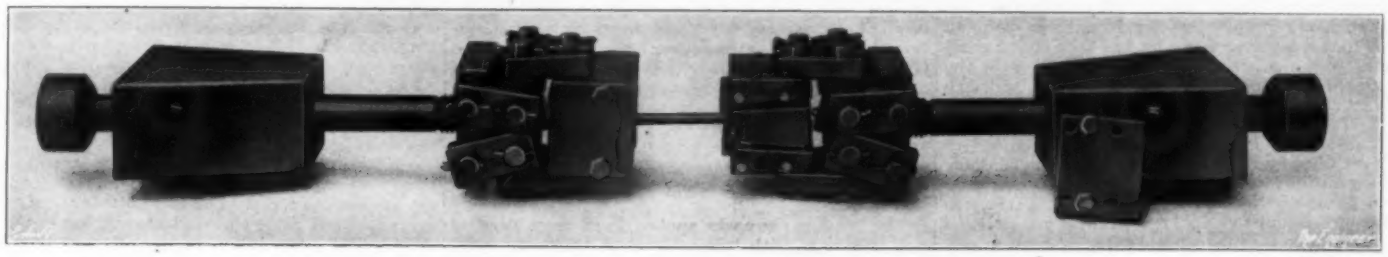
designed by an English architect, which is now a-building, and through the grounds of the far-scattered zoological gardens, out to the curious octagonal building which was once designed for a Methodist College, but which, during the war, became a laboratory for fixed nitrogen research, and, with many extensions, has remained one ever since.

To give some, even a very faint idea of the work that is being done under Dr. Cottrell's direction, it is necessary to review as briefly as may be the three commercially possible processes which can be used for the fixation of atmospheric nitrogen. The oldest is the arc-process which takes us back nearly five-and twenty years. It is extraordinarily simple and inordinately expensive. Air is passed through an electric arc. In it the oxygen and nitrogen combine into oxides of nitrogen. These oxides may be absorbed in water to form nitric acid or in alkalies to make nitrates and nitrites. As about 65,000 kW hours are required per ton of nitrogen fixed, the use of the process is only thinkable where electricity is very, very cheap. The cyanamide process came next. It is more complicated but requires only one-fourth the power demanded by the arc-process. Even then cheap electricity is essential to commercial success. It depends upon the reaction between nitrogen and calcium carbide. The result is a calcium cyanamide which may be used direct as a fertiliser or may be treated with superheated water to produce ammonia. Finally, there is the direct synthesis of ammonia from hydrogen and nitrogen—the Haber-Bosch process of 1913. It requires so little power, only one-sixteenth that of the arc-process, that cheap electricity is not essential. The principle involved in this process may be quickly explained. Hydrogen produced from water by any convenient means is mixed with air. The mixture is exploded by a spark causing the oxygen of the air and some of the hydrogen to form water, which is condensed and removed. By proper adjustment the remaining gases hold a one to three mixture ($N_2 + 3\,H_2$) of nitrogen and hydrogen, which is the ratio of these elements in ammonia. The mixed gases are then highly compressed and passed to a catalyser, which converts a small portion of them into ammonia. This ammonia seizes upon the water in the remainder of the gases and allows them to pass in a dry condition to a second catalyser, which they leave with 20 per cent. of ammonia vapour. This ammonia vapour is condensed out and the unconverted gases return to the circuit.

Towards the end of the war the need for nitrates became so great in America that the celebrated Muscle Shoals Power Station—now idle for the greater part—was hastily built for the fixation of atmospheric nitrogen. The Americans at that time knew all about the cyanamide process but very little about the direct process. Yet so promising did it appear that a plant for synthetic production was laid down. But when the urgency increased, and taking into consideration the lack of experience with that process, a cyanamide plant was also constructed. It was just completed when the Armistice was signed. But though the pressure of war no longer existed, the desire to be independent of Chile supplies still did, and America resolved to continue the production on a large scale, if for no other reason, to control at least the price of Chile nitrates. The Fixed Nitrogen Research Laboratory established as a war necessity has remained ever since, and is now engaged upon work which may still further reduce the cost of production.

The laboratory is devoting practically its whole attention to the synthetic process. In that process the employment of very high pressures, over 300 atmospheres, is essential for economy, and the main engineering work—under the direction of Mr. F. A. Ernst—is being carried on in connection with these and still more exalted pressures. As the process develops the part which electricity plays in it becomes less important, as may be gathered from the sketch of the process given above. Already over 80 per cent. of the hydrogen employed wherever the process is used is derived from water gas or from by-product coke oven gas, and only about 15 per cent. is generated by the electrolysis of water.

The Fixed Nitrogen Research Laboratory must be regarded as an educational no less than an experimental institution, for its output of technical literature is considerable. We have before us a list of one hundred and twenty papers contributed by members of the staff to various learned societies, technical periodicals, and so on. The subjects cover a wide field, though naturally they are, for the greater part, connected either directly or indirectly with nitrogen and ammonia.



SELF-ALIGNING SHACKLES

The American Engineering Council.

Amongst many pleasant memories of Washington, one that remains with us is that of a luncheon and conversation with Mr. L. W. Wallace, secretary of the American Engineering Council. Talk covered a large area, for Mr. Wallace is a man of wide knowledge and sympathies, but only the work which is now the principal interest of his life can be dealt with here. The A.E.C. is a wonderful organisation, as unlike the little Engineering Joint Council of this country as one can imagine. It is composed of thirty-eight Institutions, with a total membership of 42,000. As each of these Institutions pays into a common fund one dollar per head of its membership, the annual income of the A.E.C. is £8000. There is a General Council which meets once a year. On it one delegate per thousand members of each of the subsidiary Institutions sits. From these delegates an Executive Council of thirty-five is appointed. One has only to contrast this organisation with the E.J.C., which has only five constituent institutions, no separate funds, and no power, to see how far American engineers have advanced towards united action. Indeed, one of the principal objects of the Council is to see that engineers and the interests of engineering are properly recognised by the legislature and the public, but with the large funds at its disposal it is, moreover, able to enter upon investigations of importance to the engineering industry as a whole. Amongst its latest activities of that kind was a very extensive inquiry into the relationship between increased production and industrial accidents. This investigation showed that, whilst in the period taken the rate of production had increased by 14 per cent., the accident rate had fallen by 7 per cent. In this country the Ministry of Health, which draws upon the taxes for its funds, is doing similar work. It is typical of the American attitude towards such matters that it is being done by private enterprise in the United States.

TEST PIECE IN MACHINE

(To be continued.)

The British Association.

No. II.*

SECTION G.—ENGINEERING.

At the first meeting of Section G on Thursday, September 1st, the Recorder, Professor F. C. Lea, announced the receipt of a message from the retiring President, Sir John Snell, regretting that his official duties prevented him from being present to induct the new President, Sir James Henderson, into the chair. In the circumstances, Sir James took the chair without formality, and immediately read his Presidential address, an abstract of which appeared in our last issue.

Sir Henry Fowler (President of the Institution of Mechanical Engineers), who proposed a cordial vote of thanks to the President for his address, said Sir James had rather given the impression that he had been concerned all his life with academic work, but reading between the lines it was apparent that he had come up against the problems which were familiar to the practical engineer. The address also showed how closely he had kept in touch with questions of finance which had such a great bearing on the development of invention.

Sir William Ellis (Past-President, Institution of Civil Engineers) seconding the vote of thanks, said that those whose duty it was to make speeches from time to time would be grateful to the President for the information he had given in his address. As one who had the duty of scrutinising a large number of inventions from time to time, he had noted that a large number came from men who were engaged in other professions than engineering, and he had been struck with the fact that had these people consulted an engineer they would, in most cases, have learnt that their proposals were heresy and contrary to nature's laws. In that way a vast amount of labour and expense would have been saved. But it was a difficult matter to convey to such inventors the fact that their inventions must be failures. He personally had tried to do so in various ways but he had usually failed.

Sir Charles Parsons, supporting the vote of thanks, said that judging from the number of inventions that came before him, there seemed to be a superfluity of good or bad seed. Of course, the inventors always thought their inventions were good seed, but they generally were disappointed. There were really two sides to the question that had been raised by the President as to the need for more publication of previous unsuccessful efforts because such publication might actually be a discouragement to an inventor. When he started on the steam turbine, had he known that some 100 patents for turbines had been taken out during the previous half-century, he might not have gone on with the work himself. When he was at the Board of Inventions during the war, suggestions came in at the rate of 2400 per week, but only a fraction of 1 per cent. were of any use, and they were usually not new. As to the difference in the position of the inventor in America and here, Sir Charles said he did not think the conditions in America were so favourable to the inventor as they were in this country. For instance, it was very difficult to enforce patent rights in America. A vast amount of money would be involved, and unless the patent was a powerful

* No. I. appeared September 2nd.

one, it was hopeless to start a patent action either against an individual or against the Government. That had been his own personal experience. A patentee was dealt with far more fairly and favourably in this country than in America; that again had been his personal experience. That was a strange fact, for as we looked upon America as a progressive country we should expect the inventor to be encouraged.

Professor A. Barr said that having been engaged on invention for forty years, he felt that nothing in the shape of laws could be put down for the guidance of inventors—so much depended upon the conditions and the particular problem. He agreed that if a history of successful invention was written it would be misleading because it would leave out the unsuccessful work which was extremely instructive. A great many people thought inventions were all happy thoughts; they might be, but they took a great deal of working out. Too many people made the mistake of not submitting their inventions to people who had had experience, but, on the other hand, people who had had experience were very often exceedingly bad guides. He had found many such men apt to say that what had not been done could not be done. The successful inventor must be free from anxieties as to pecuniary results, and free from anxiety as regards his circumstances. Above all, it was essential to be determined to succeed and to get over difficulties, however great they might appear.

LUBRICATION.

A discussion on "The Lubrication of Surfaces Under High Loads and Temperatures" was then opened by Dr. T. E. Stanton. After a brief statement concerning the theories of lubrication put forward by Osborne Reynolds and Tower, Dr. Stanton said that the check on the theory afforded by Tower's experiments was only a partial one and consisted of a comparison of the theoretical and observed pressures and torques. That was due to the fact that when Tower's experiments were made, the importance of the radius difference of bearing and journal was not recognised, and no attempt was made by Tower to measure it. It was, therefore, impossible to obtain from Tower's data any check on the variation of attitude and excentricity of the bearing throughout the range of loading.

Dr. Stanton then described an investigation recently carried out at the National Physical Laboratory for the Lubrication Research Committee of the Department of Scientific and Industrial Research, in which an attempt had been made to measure the variation of attitude and excentricity in the case of a journal and bearing having a known radius difference. As the method necessitated the measurement of small fractions of the radius difference, it was obviously desirable that the experiments should be on as large a scale as possible. For that reason the diameter of the journal was made 7.6in., and the length 8.5in., the measured radius difference being 0.011in. The journal formed an extension of a solid shaft 4in. in diameter, revolving in a pair of Hoffmann roller bearings. It was thus possible to fit an oil bath completely round both ends of the journal, and thus ensure an adequate supply of lubricant to the "on" side. The measurement of the relative displacement of the bearing and journal was undertaken by Mr. H. A. Thomas, of the Electricity Department of the National Physical Laboratory, by his electrical inductance method. From these observations the displacement of the bearing in two directions at right angles was estimated, and its attitude and excentricity were then calculated. Those values up to a load of 9000 lb. on the bearing, when running at a constant speed of 134 revolutions per minute, were shown diagrammatically. The excentricity at the maximum load was 0·77. Up to an excentricity of about 0·5 the agreement between theory and observation was fairly good, but the effect of increasing the load beyond the value corresponding to that displacement produced a deviation of the point of nearest approach in the direction of the crown of the bearing, instead of in the opposite direction as indicated by the theory. The cause of that deviation was not immediately apparent, and some time was spent in examining the theoretical conditions under which the observed movement of the bearing could take place. It was eventually noticed that for high values of excentricity, the pressure in the oil film in the neighbourhood of the extremity of the "off" side of the bearing became negative over a considerable arc. Under the conditions of the experiments, it was probable that in practice that negative pressure could not be maintained, owing to air being drawn into the space between the surfaces at the "off" side, with the result that the extremity of the oil film would retreat towards the crown of the bearing. That would afford an explanation of the tendency of the point of nearest approach to set itself directly over the axis of the shaft, which was actually observed. To check that assumption, a series of pressure holes in the bearing in the central section extending from the extremity of the "off" side to about 20 deg. from the vertical on the "on" side were connected by thin copper tubes to a series of Bourdon gauges, care being taken to withdraw all the air from the Bourdon tubes and the connecting pipes. The pressure distribution under any given load could then be observed. It was found that the pressure at a point 75 deg. to the "off" side of the crown fell to atmospheric pressure when the load reached a value of 25 lb. per square inch of projected area of the bearing, and that for a pressure of 200 lb. per square inch the extremity of the film had retreated to a point 45 deg. from the crown. It was obvious that increase in the load could not be carried much further without seizure of the surfaces. This phenomenon afforded a probable explanation of the low values of the seizing pressures which were observed in Tower's experiments under the most favourable conditions for the formation of an oil film, *i.e.*, with the lower surface of the journal immersed in an oil bath. For example, the seizing pressures for the different oils tested reckoned on the whole projected area of the bearing were found to be 573 lb. per square inch with rape oil, and 625 lb. per square inch with mineral oil. The actual pressures on the oil film were, of course, very much larger, but on the assumption that the film extended over the whole arc of the bearing, it did not appear that the excentricity was more than 0·6, which left a considerable margin for higher loading before contact of the surfaces would take place. The explanation of the low seizing loads appeared to lie in the retreat of the "off" side extremity of the film towards the crown of the bearing, with consequent heating and rapid reduction of film thickness.

The foregoing remarks applied in all cases to what was known as bath lubrication. In the commercial testing of bearing metals and lubricants for high duty, as regarded pressure and temperature, which was carried out at the National Physical Laboratory, the method of bath lubrication was too difficult and elaborate, and it was customary to supply the lubricant to the unloaded side of the bush under test by means of an oil pump, which delivered the oil at a fixed rate—usually 0·5 oz. per minute. In that method, which had been developed by Mr. C. Jakeman, the observations of frictional torque were made over a range of temperature extending from air temperature to the temperature at which seizing occurred. For tests of bearings under high loads, no artificial heating was required, as the heat developed was sufficient to enable a series of observations of torque and temperature to be taken at gradually increasing temperatures. For low pressures the temperature of seizing could only be reached by applying heat to the journal, and for that purpose the journal was made hollow to take a specially designed gas burner. The bearing was tested in the form of a complete bush, with no oil grooves of any kind.

When a bearing was tested in that manner, the coefficient of friction at first fell as the temperature rose, until a temperature was reached at which the friction reached a minimum value. If the temperature were further increased, the friction gradually rose, until at a certain critical temperature—called the seizing temperature—there was a very sudden increase in the friction, and if the machine were not stopped seizure of the surfaces took place. It had been found possible to prevent damage to the surfaces by using a flat pulley on the belt-driven shaft of the machine, so that when the extra torque came on, the belt was thrown off the pulley. Typical friction—temperature curves obtained in that way were shown by Dr. Stanton, for three oils whose viscosities and densities were not very dissimilar, but which behaved very differently under the test. Two of the oils were straight mineral oils—acidity < 0·06 per cent.—and the third was a fairly pure castor oil. When tested in the Deeley machine for values of the statical coefficient of friction under conditions of boundary lubrication, the results obtained were :—

Lubricant.	Coefficient of Friction.
No. 1 mineral oil	0·125
No. 2 mineral oil	0·126
Castor oil	0·08

That relatively low value for the coefficient of friction for the castor oil was in agreement with the known merit of that oil under boundary lubrication conditions. Under the very high load of 2500 lb. per square inch of projected area of the bearing, No. 2 mineral oil gave a minimum coefficient of friction of 0·001, and a seizing temperature of 224 deg. Cent., which might be regarded as a remarkably high performance. No. 1 mineral oil, on the other hand, gave a minimum coefficient of friction of 0·0018, and seizing took place at 94·5 deg. Cent. The castor oil occupied an intermediate position, with a coefficient of friction of 0·0012, and a seizing temperature of 138 deg. Cent.

The main conclusions derived from the tests were :—(1) That the known merit of castor oil in preventing failure of bearings running hot is not due to inability to seize, this happening, in fact, at a relatively low temperature, but is due to the low value of the coefficient of friction under boundary lubrication conditions. (2) That it is possible to obtain a straight mineral oil which maintains itself in the film condition up to temperatures far in excess of the limiting temperature for castor oil. (3) That mineral oils of the same degree of acidity and unsaturation, and for which the values of the viscosity and density are approximately the same, may vary greatly in their capacity to stand up to high temperatures under conditions of film lubrication.

It was clear, therefore, said Dr. Stanton, that oils which possessed exceptional lubricating properties under boundary lubrication conditions were not necessarily the best for purposes of film lubrication, and *vice versâ*. If that conclusion were correct, it followed that in the search for a lubricant which would enable a machine to be run at really high temperatures and at a high efficiency, *i.e.*, under film lubrication, it was not only the chemistry of the lubricant, but its physical properties, which had to be studied.

Sir William Hardy, whose name was on the programme to follow Dr. Stanton, was unable to do so as he was abroad. His letter notifying his absence was received some time ago, but was overlooked; hence the appearance of his name on the programme for the day.

The President said it was remarkable that two mineral oils with physical properties more or less alike should behave so differently.

Sir Charles Parsons said the work being done by Dr. Stanton and his colleagues at the National Physical Laboratory was admirable and exceedingly valuable, because engineers, in rushing through their work, as they had to, could not pause to consider such questions nor had they the apparatus with which to make the experiments.

Sir T. Hudson Beare asked if Dr. Stanton had any theory to explain the result he had described, and Dr. Stanton replied that he had no theory yet.

Sir Richard Threlfall asked if anything in the way of chemical examination of the oils had been done to decide what chemical substances were in the oil. Dr. Stanton said nothing beyond acidity and saponification tests had been attempted at the Laboratory, but several samples had been sent to Sir William Hardy.

Sir Richard Threlfall said it seemed to him that there might be some unrecognised constituent in the third oil which was not in the first two, and that might be the key to the whole matter. In that event, it would be in keeping with Sir William Hardy's views as to the dependence of the friction on the chemical constitution of the oil.

Dr. Stanton said that Dr. Morgan had looked into the question from the distillation point of view, but had not been able to detect any difference between the oils.

Sir Charles Parsons made the remark that Dr. Stanton's work had revolutionised marine engineering practice, because years ago it was the custom to put in grooves in shafts and bearings where the pressure was greatest. Now, however, that was not done.

Professor F. C. Lea recalled that practice when he was an apprentice, and said he used to think it possible that the grooves formed, in a sense, a reservoir of high-pressure oil. Was it certain that that was not the effect obtained? All types of engineers found grooves extremely useful in practice.

Sir Henry Fowler said that grooves were still used in locomotive work, and the oil was maintained in the grooves by the use of a little marble of wool. In that way, bearings on the railways had been known to run for 2000 million revolutions for one failure. He understood that the experiments described by Dr. Stanton had been carried out with a bronze bearing and a steel shaft, but it should be possible to use white metal instead of bronze. That might do away with the need for the very fine and careful fitting which was a feature of the bearing used by Dr. Stanton. With white metal, he had been able in certain cases to go to pressures considerably higher than had Dr. Stanton, and for a reciprocating part he had got up to 9000 lb. per square inch. It was a little perturbing to be told that the coefficient of friction of boundary lubrication was 100 times that of film lubrication, and he was led to ask when was boundary lubrication likely to occur in the case of a locomotive which did not enjoy the advantage of a motor car engine which ran practically in a bath of oil?

Mr. A. H. Fisher asked whether there was any possibility of oxidation giving rise to the presence of materials of a gummy character and so causing thickening of the oil during the progress of the experiment itself.

The President, in bringing the discussion to a close, said the paper emphasised how very empirical the science of lubrication was. We used to think we knew a great deal about lubrication from Osborne Reynold's theory and Sommerfeld's equations, but Dr. Stanton was himself the first to knock a hole in those theories when he discovered the great influence that pressure had on the viscosity of the oil. At one time, under Reynold's and Sommerfeld's theories, viscosity was supposed to be a function of temperature, but Dr. Stanton had shown that it was also a function of pressure.

THE ELECTRIC DISCHARGE.

The final paper in Section G (Engineering) on Thursday, September 1st, was by Professor William Cramp, Professor of Electrical Engineering in Birmingham University, who exhibited and described a hydraulic model of the electric discharge. He pointed out that the electric discharge, whether in the form of a spark, the current through a neon tube, an ordinary arc or a point-o-lite lamp, had one characteristic which distinguished it from conduction currents. No current passed across the arc until a certain maximum pressure had been reached, but after that the current could be maintained by a very much lower potential difference. In some cases the slope of the

potential current characteristic was negative; in others, as, for instance, the neon tube, it was positive. Special forms of discharge, such as the Poulsen arc, had a characteristic intermediate between that of the neon lamp and that of the ordinary arc. The fact that the discharge potential difference might be much lower after the current had once begun than at the time of breakdown enabled the discharge in its various forms to produce surges and oscillations, provided that the appropriate apparatus, such as resistances, condensers and inductances, were included in the circuit.

Since in a circuit consisting of a tube containing liquid the resistance might be represented to some extent by fluid friction, inductance by mass, and capacity by a store of fluid, it followed that, if such a tube were provided with apparatus which would allow of the free escape of liquid when a certain pressure was reached, and with a continuation of that escape at a lower pressure afterwards, the condition of the electrical discharge circuit might be imitated.

Such an arrangement entailed the use of a valve which would open at predetermined pressure and remain open until a lower pressure had been reached. This was not easy to provide by mechanical means, but it might easily be obtained by making use of the phenomena of surface tension. If a syphon tube was made of gradually increasing diameter the potential energy of the meniscus diminished as the diameter increased, and consequently there was a tendency for the meniscus to contract against the gravitational force of the fluid in the tube. If, therefore, the amount of fluid in the tube increased the meniscus expanded until a certain limit was reached, when it allowed fluid to escape. Such an arrangement formed a very perfect automatic valve for the purpose of a model to imitate the electric discharge. It was possible to imitate the production of electric oscillations by the quenched spark, the behaviour of the neon lamp when fed from a constant-pressure circuit with a resistance in series and condenser in shunt, and the behaviour of certain phases of the Poulsen arc as confirmed by photographs taken of cathode ray oscillograms.

Professor G. W. O. Howe said that hydraulic analogies were always useful in teaching students electrical phenomena, although he recalled the case of one student who complained at being given hydraulic analogies when he had asked electrical questions. That particular student eventually left electrical engineering and went in for Montesorri teaching. An interesting point in connection with the paper was the distinction between the Duddell arc and the Poulsen arc. That subject had not been dealt with in any English paper, but it had been dealt with fully in German papers by Pedersen, of the Poulsen Company. Pedersen had published numerous papers dealing with cathode ray oscillograms, but he never referred to the falling characteristic. It was always the striking voltage or the extinction voltage, but never the negative resistance or falling characteristic. Personally, he had always regarded the subject as being divided into two separate phenomena: the Duddell arc, with its non-extinguishing oscillation, which he had always regarded as being due to the falling characteristic; and the Poulsen arc, which worked under conditions where it was extinguished at each oscillation. Professor Cramp had dealt with the two phenomena as two aspects of one common phenomenon.

Professor E. W. Marchant agreed with the latter view expressed by Professor Howe and at the same time remarked that Professor Cramp's model was a much simpler one than that used by Duddell for showing the oscillatory arc.

The President said it seemed that the mathematician could not help in the problem yet, but he hoped Professor Cramp would be able to explain it mathematically.

Professor Cramp said he well knew the subject was controversial, and he would like to have it out with Professor Howe and Professor Marchant. If those gentlemen could show him how by means of direct electrical pressure and a falling characteristic it was possible to transfer energy from the direct to the alternating side, he would be only too pleased to learn. He did not see how it could be done without a hysteresis loop. The difficulty in analysing the problem mathematically, which he had done, was the discontinuity of the equations. The problem had to be taken in three sections and it was only possible to get an approximate result.

(To be continued)

REFERRING to the possibilities for the establishment of iron and steel works in Queensland, the State Minister for Mines (Mr. A. J. Jones) recently drew attention to the fact that there are many iron ore deposits in Queensland. At Woodstock, in the Townsville-Bowen district there are exceedingly rich deposits, while the Biggenden ore has been tested by smelting, and has proved to be a valuable deposit of magnesite iron of very high quality. The deposit at Mt. Leviathan, in the Cloncurry district, has been estimated to contain 10,000,000 tons of ore above ground, while Mt. Philp, also in the Cloncurry district, has been estimated to contain 30,000,000 tons of ore above ground. All the evidence gathered, and all the known geological data, show that there is ample raw material in Queensland for the operation of steel and iron-works.

The Shipping, Engineering and Machinery Exhibition.

No. I.

IN a special twenty-page Supplement published with this issue we give an account of some of the items being shown at the Shipping, Engineering and Machinery Exhibition which was opened at Olympia, London, yesterday (Thursday) and which is to remain open for the next fortnight. It is not pretended that that Supplement includes descriptions of the majority or even of the most important and interesting of the exhibits. In what follows, however, we continue our account of the exhibits and in succeeding issues we hope to complete as full a description of them as the exigencies of time and space will permit.

THE LEA RECORDER COMPANY.

Amongst the exhibits of the Lea Recorder Company, of 28, Deansgate, Manchester, is a recorder exactly similar to that which has been constructed for the Swansea waterworks for dealing with a widely fluctuating flow of water over a combined V notch and rectangular weir. The instrument is shown in Fig. 2, while Fig. 1 shows the construction and dimensions of the weir itself. The object for which the apparatus has been designed is to obtain a record of the flow from a considerable catchment area in the mountainous region outside Swansea from which the water supply of the town is obtained. This flow of water varies from 10,000 gallons per hour in periods of dry weather up to 5,000,000 gallons per hour when

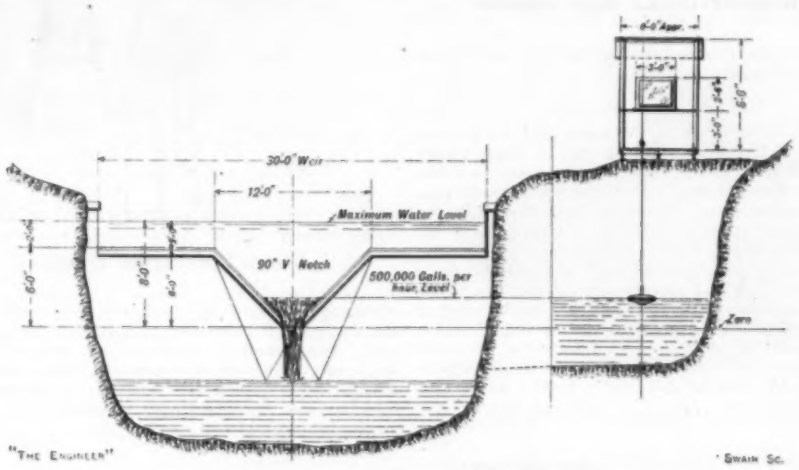


FIG. 1—COMBINED V-NOTCH AND RECTANGULAR WEIR

the 90 deg. V notch is flowing to its maximum capacity and up to still larger quantities in flood time when the water pours over the top of the 30ft. weir. The instrument has been designed so as to give clearly defined chart records of the smallest flows, moderate flows, and flood flows. In other words, whilst the instrument is capable of measuring a small trickle—comparatively—it can also cope with flows one

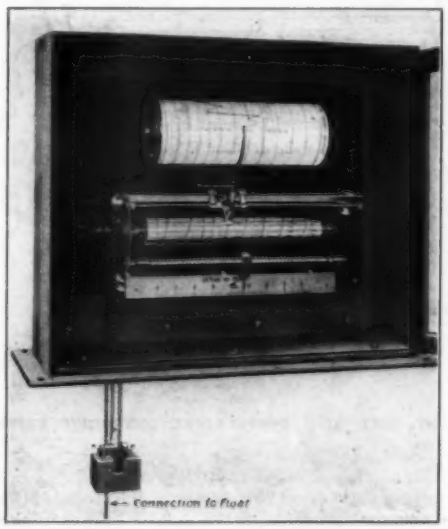


FIG. 2—LEA WATER RECORDER

thousand times as great. In all cases of this kind, of course, the dry weather flows are the most important, and there is nothing more accurate for this purpose than a V notch. Not only is a V notch suitable for measuring very small flows, but it has a great overload capacity, *e.g.*, whilst a flow 1ft. deep in this 90 deg. V notch represents a little over 50,000 gallons per hour, a flow 6ft. deep is a hundred times as much, or 5,000,000 gallons per hour. The instrument is actuated by means of a roller chain from a large float placed in a recess some distance away from the weir, the maximum movement of the recording pen being 15in. The chart drum is 6in. diameter and revolves once in seven days, so that the only attention required is to remove the chart once a week. Other features of this firm's interesting stand are coal meters for use with chain grate stokers, Lancashire boilers and pulverisers.

GRIMSTON, PRICHARD AND PLUTTE, LTD.

The stand of Grimston, Prichard and Plutte, Ltd., 83, Queen-street, London, E.C. 4, is devoted to the products of continental firms, and among the machines exhibited, one of the most interesting is the wire-drawing bench, illustrated in Fig. 3. It is, as will be seen, of the continuous type, and is noteworthy on account of the very high speed at which it is claimed, the wire can be drawn. It is, in fact, intended to be run at a linear speed of 4000ft. per minute, and can be driven up to a speed of 5000ft. per minute, rates of drawing which are considerably in excess of average British practice; but the makers admit it is hardly to be recommended, as other factors besides the construction of the machine have to be taken into consideration. The wire is drawn through eighteen dies, and the two die-boxes have a reciprocating motion which reduces to a minimum the cutting in of the wire into the cones. The lubrication of the dies is effected by the wire being led through a grease box, through which a pump presses the lubricant continually, the wire being intensively cooled by this arrangement. The drive of the machine is through fast and loose pulley, and the internal gearing runs in an oil bath. Heavy ball bearings are fitted to most of the bearings. This machine is, of course, for the drawing of fine wires. It will draw wire from ·028in. down to ·0048in.—40 S.W.G.—and down the range of finer wires than this to ·0060in. down to ·0016in.—48 S.W.G. A protective device is included to stop the machine should the wire being drawn become entangled in any way. The wire can be drawn in the usual way in coils on the block—as shown in the illustration—or, by changing the head, spooled straight away on bobbins to allow the wire to be annealed without re-spooling. The arrangement

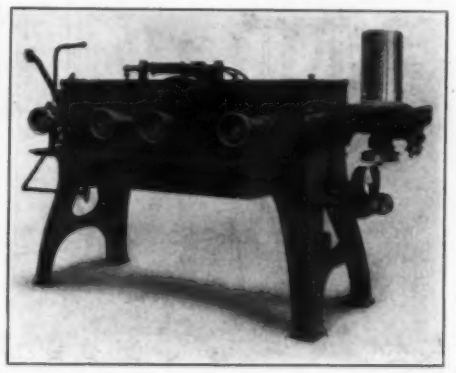


FIG. 3—WIRE-DRAWING BENCH—GRIMSTON

for the spooling attachment, in order to keep the tension of the wire even whether the spool is almost empty or nearly full, is particularly ingenious.

The little drill shown in Fig. 4 is also shown on this stand, and is noteworthy in that it has two chuck spindles set at right angles to one another, and having different offsets from the centre line of the machine. These two spindles are permanently geared together, but run at different speeds with a ratio of about 7 to 1. Normally, the drill is worked by an electric motor, but, as is shown by the engraving, a hand crank can be inserted in the slow-speed spindle, and then, if there is no current available, the other spindle can be

rotated at some 400 revolutions per minute. Alternatively, the motor will generate sufficient voltage to light a 10-watt electric lamp. Screw feeds can be adapted to the rear ends of both drilling spindles, while the chuck is fixed in a No. 1 Morse taper socket.

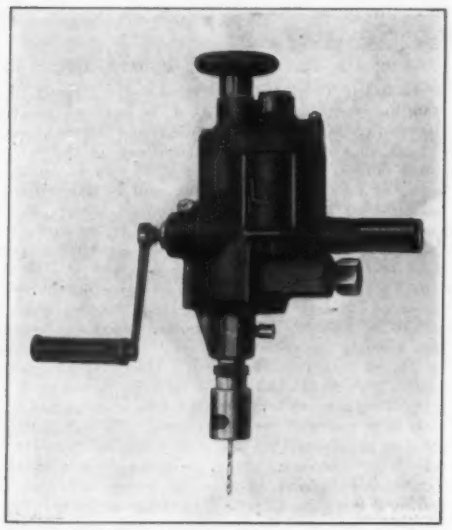


FIG. 4—DOUBLE-SPINDLE DRILL—GRINSTON

On the same stand there are some belt-driven riveting hammers, braiding machines, &c.

VICTORY VALVES, LTD.

Amongst the exhibits of the associated companies, Victory Valves, Ltd., and Bolton's Superheater and Pipe Works, Ltd., Adswood, Stockport, are the well known wrought steel valves and boiler mountings for the high-working pressures and temperatures which are now in vogue. Of more than passing interest is the method in which under Gray's patents the valve seatings are held in position, allowing for freedom of expansion and contraction without distortion under all changes of temperature. Gray's internal by-pass, which is fitted as standard to these valves, not only serves as an efficient by-pass but at the same time ensures that there can be no accumulation of pressure inside parallel slide valve bodies under any working conditions, and this obviates one of the sources of trouble that have hitherto been experienced with this type of valve with the external by-pass. Locomotive engineers will be interested in the new Cruse-Gray high temperature superheater, which is illustrated in Fig. 5. The salient feature of this appliance is the improved type of element employed. This is simple in design, and is claimed to be exceptionally efficient for the production of high superheat temperatures. The steam is passed through the elements in a thin film between external and internal heating surfaces, and it will be noted that the gases used for the internal heating surface are reserved for superheating alone, giving high efficiency throughout the full length of the elements. The construction of the whole superheater is carried out in wrought steel, all castings having been entirely eliminated. The header construction has been very much simplified as against the usual types hitherto employed, while every element is accessible without interference with the remaining elements, and all elements are easily accessible for cleaning purposes. Other interesting developments in superheating, such as the Bolton-Gray high superheat, high pressure, sectional superheater, for all types of cylindrical and water-tube boilers, are also on view, and examples of welded pipework for high pressures and temperatures. An efficient apparatus for the prevention of the escape of hot gases from, and the leakage of cold air into the downtake flue of Lancashire and similar type boilers, is the Gray expansion downtake, to which reference has been previously made in THE ENGINEER. Besides effectively sealing the downtake this apparatus also strengthens the downtake walls and its installation reduces the production of black smoke.

AUTO-KLEAN STRAINERS, LTD.

On the stand of Auto-Klean Strainers, Ltd., of Tower House, 40, Trinity-square, there is shown an extensive range of the firm's patented oil-straining appliances, which are now supplied for oil engine lubricating systems, hot and cold boiler fuel systems, and for general industrial purposes, including motor cars. The strainers, which are on view at Olympia, are mostly, however, of the marine type. They cover a wide field of application, and vary in size from a ¼in. bore strainer for the smallest motor boat engines up to a 6in. bore strainer for H.M. naval ships, and for large liners and cargo vessels. It will be recalled that the essential principle of the Auto-Klean system of edge straining is the employment of a pile of thin steel discs mounted on a central spindle and interleaved with stationary cleaning blades. When the pile is rotated by turning the handle attached to the spindle on which it is mounted—see Fig. 6—any dirt or sediment which may have collected on the edge of the discs is automatically wiped off and falls into the sump in which the cartridge is housed. The sump can be cleaned out periodically by removing the cartridge, which is quickly done. The arrangement shown in Fig. 6 is for the crank case of a launch engine, while in Fig. 7 we illustrate a complete 2in. bore strainer, which is supplied to marine oil engine builders for fitting to their own bed-plates and in the fuel and lubricating oil systems. Units of this type are built for pipe bores up to 6in.

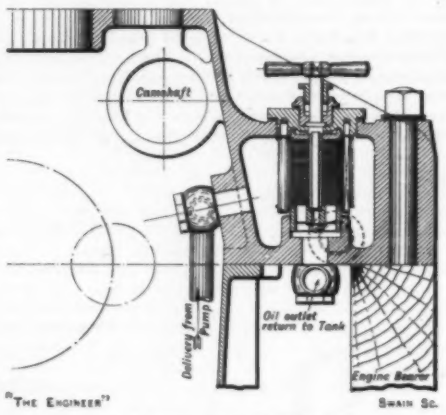


FIG. 6—AUTO-KLEAN STRAINER

Another type of strainer which is exhibited is that which has been designed to convert the ordinary gauze strainer to the Auto-Klean principle. It is now used, we learn, by several of the British shipping companies, and has been installed in all the motor vessels of the Pacific Steam Navigation Company, Ltd., and also in the engine-rooms of the large motor liners Asturias and Carnavon Castle. Other large diameter strainers are in use in the new ships of the Orient Line. As an indication of the durability and reliability of these particular appliances, the company points out that it has not as yet received any orders for spare parts or renewals for the Auto-Klean strainers it has already supplied, many of which have now been in unbroken service for several years.

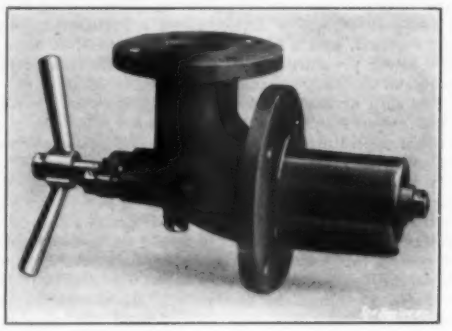


FIG. 7—AUTO-KLEAN OIL STRAINER

RICHARD KLINGER, LTD.

The firm of Richard Klinger, Ltd., of 120, Southwark-street, London, S.E. 1, is showing a selection of its special packings, jointing materials, valves and steam fittings. We have chosen for description a new type of gauge glass, which has recently been placed on the market, and is of interest on account of its having been specially designed to work with high-steam pressures and temperatures. Referring to drawing, Fig. 8, it will be seen that the fitting comprises an upper and a lower main gauge cock, the gauge body and a drain cock. These parts are so arranged that all the joint-making faces can move together under expansion, so that there is no possibility of initial stresses being imposed on the gauge fitting, either when it is being assembled or when in service. In the drawing shown, the gauge cocks are of the flanged type, but screwed cocks are also made. From the sectional drawing of the lower cock, it will be seen that a steel isolating plug is provided on each of the main cocks. This plug is locked in position by means of a grub screw, but when it is screwed down, it cuts off all communication with the steam or water passages, and enables all the other parts of the gauge to be dismantled and examined with ease and safety. The plugs are kept tight by means of a circular passage around them, which is filled by a special packing composition, and is pressed down by a ram screw.

An automatic ball-closing device is also provided between each of the main cocks and the gauge body.

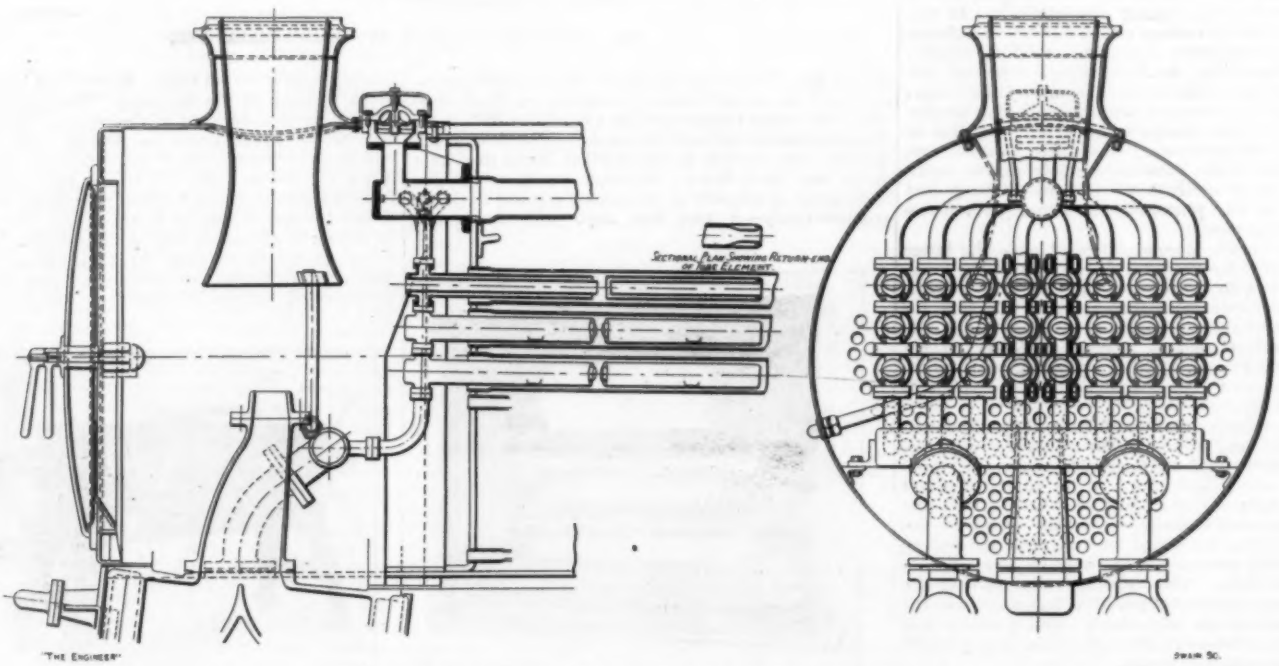


FIG. 5—CRUSE-GRAY HIGH TEMPERATURE LOCOMOTIVE SUPERHEATER

A feature of the main cocks and also the drain cock is the interchangeble packing sleeve, made of highly compressible material. When the gland nut is tightened up an even pressure is exerted upon the sleeve which makes the plug of the cock both water-tight and steam-tight. The sleeves are provided with an external ridge, connecting with grooves in the body casting, which prevents displacement of the bushed parts in the sleeve when the gland nut is being tightened.

We need hardly refer to the gauge body, as details of its construction can be seen from the views we reproduce. A standard Klinger reflex glass is used, which gives a distinct indication of the water level, even though the gauge may be fixed very high above

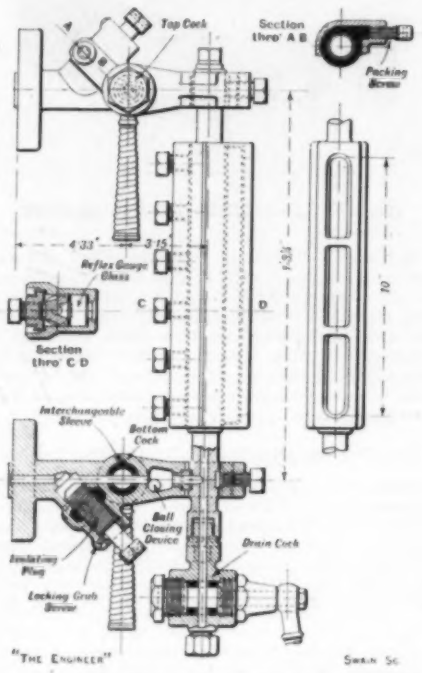


FIG. 8—HIGH-PRESSURE GAUGE GLASS—KLINGER

the firing floor. The cage in which the glass is housed is closed by a wedge-shaped saddle piece, and a single row of stout square-headed screws is employed instead of the double-row of screws used in some earlier designs.

Among the various types of valves which are shown, we single out for illustration one of the firm's seatless piston valves, which has been designed for use on marine oil engine starting and injection air bottles, either as a drain valve or control valve. A section through such a valve is reproduced in Fig. 9. It consists essentially of a smooth cylindrical plunger, which moves with a sliding motion through jointing rings of flexible material, which are separated by a

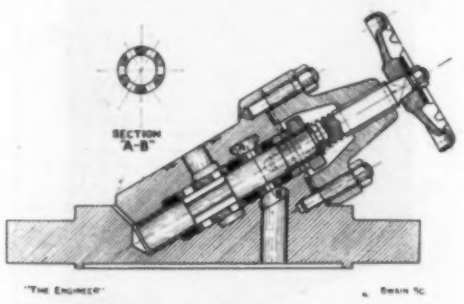


FIG. 9—SEATLESS PISTON VALVE—KLINGER

metal bush furnished with ports through which the air passes. It is claimed that only the lower part of the plunger is exposed to high velocity effects, and any wear which may be caused does not in any way affect the tightness of the valve when it is closed. There is no spindle stuffing-box, and the general design is simple in character. Such valves are built in forged steel, and may be employed for high pressure and high-temperature steam work. For the steam valves above 2in. in diameter a balanced plunger is provided, giving very easy closing.

H. L. Mason.

The valves which are to be seen on the stand of Mr. H. L. Mason, of 66, Victoria-street, S.W. 1, two of which are illustrated in Figs. 10 and 11 respectively, have been designed on a multi-seat system to overcome the difficulties experienced with the control of steam, fluids and gases at high pressures and temperatures. Beneath the usual mushroom valve is a piston which forms an auxiliary valve by contact with an asbestos ring under the metal seat. The valve is opened and closed in the ordinary way by means of a spindle and hand wheel, but the dual valve system is so arranged that the piston valve entirely prevents the flow whenever the metal valve is near enough to its seat to cause wire-drawing. For this reason, the scoring of the main closure members is claimed to be entirely eliminated.

The moment of "cracking"—drawing Fig. 11, shows the valve $^1/_{16}$in. above the cracking point—is shown clearly on an indicator. The valve can be left with the finest possible flow passing under the piston without any damage occurring as all the scoring

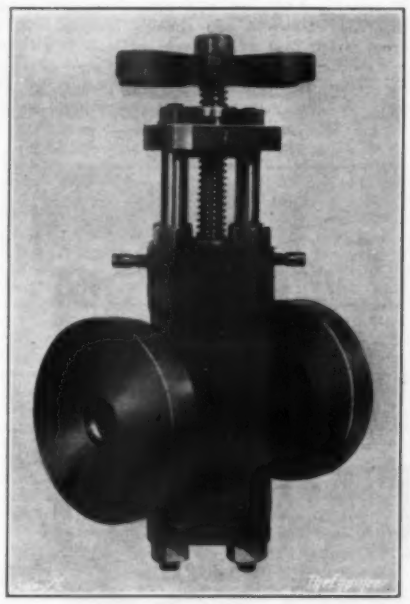


FIG. 10—MULTI-SEAT VALVE—MASON

incidental to the extra velocity of the flow takes place on metal surfaces, which form no part of the stop valve system. This arrangement also does away with the need for a by-pass.

The main seat is a loose fit in the body. It is inserted through the bottom of the casing and is backed by the asbestos ring of the piston valve in such a way as to prevent the passage of steam round it. The clearance between the seat and diaphragm is such that a distortion of the latter will not affect it, and the gland which controls the tightness of the piston valve ring takes all the strain incidental to the

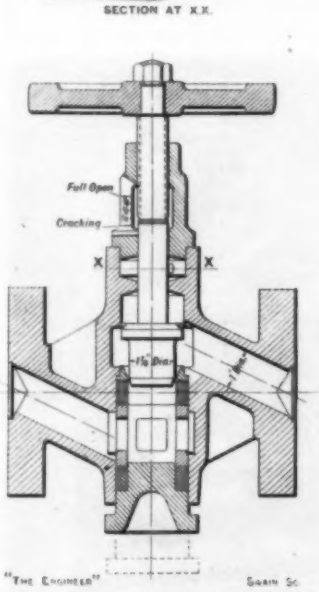


FIG. 11—SECTION OF MASON VALVE

closing of this valve. Most of the trouble due to distortion has, the designer claims, been eliminated by this method of fixing the seat, and the wear on the piston ring can be adjusted from time to time as necessary. When the valve is screwed down to the closed position, the whole arrangement tends to become tighter, while the friction on the piston is relieved the moment the spindle is unscrewed.

Each of the two valves is designed so that it is capable of holding up by itself the flow of steam at a very high pressure and temperature, and this fact not only makes the valve doubly secure, but it enables the principal metallic seating to be eased back in a cold valve in such a way as to avoid spindle strain when warming up. A neat form of spindle packing is used which may be tightened by two turn screws fixed longitudinally to the packing gland, and shown in the upper part of Fig. 11. Incidentally, the metal valve assists the work of the piston valve, and *vice versâ*, so that the systems actually last longer in co-operation, and a life many times longer than that of ordinary valves is claimed.

An interesting extension of the system has been introduced by the provision of a third valve and seat where called for, in such a way that the operation of changing seats and valves can be performed while full pressure is on the body of the valve. Fig. 10 illustrates a valve of this type. In the larger valves the third valve is also the balancing agent, and in these the valves and seats can be changed under pressure on site in less time, we understand, than is ordinarily taken to open up and change the seat of a cold valve in the workshop.

A full range of valves of the particular kind we have described is, we understand, in course of preparation. Mr. Mason also shows a model of such a valve for application to inlet and exhaust purposes on an internal combustion engine.

The Anglo-Swedish Electric Welding Company, Limited.

Four standard sizes of this company's self-regulating welding sets are shown. The generators—see Fig. 12—may be driven by electric motors or oil engines, and portable or stationary sets are supplied. A noteworthy feature of the sets is that they have no switchboard, the makers having found that for welding purposes switchgear and instruments are unnecessary. Although the sets are designed mainly

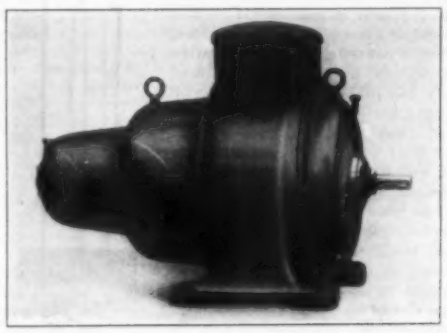


FIG. 12—ANGLO-SWEDISH GENERATOR

for use with the Swedish Electric Welding Company's own electrodes, they may be used with other electrodes. An example of one of the the engine-driven sets is shown in Fig. 13, the engine being of the Aster four-cylinder type. The generator can be regulated to give from 40 to 250 ampères, and is capable of supplying 300 ampères intermittently. The set is suitable for welding with iron and steel electrodes from 2 mm. to 7 mm. diameter, and with brass electrodes up to 5 mm. diameter. The generator is totally enclosed, and all the regulation is done by a single hand wheel, mounted in front of a graduated

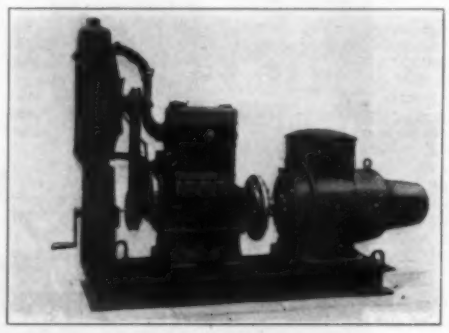


FIG. 13—ANGLO-SWEDISH WELDING SET

scale. The company is showing a new motor generator set, capable of being regulated from 10 to 125 ampères and of giving 150 ampères for short periods. It is suitable for use with iron and steel electrodes ranging from the smallest size up to 4 mm. It may also be used intermittently with 5 mm. diameter electrodes.

C. A. Parsons and Co., Ltd.

The principal exhibit on this company's stand is a motor generator set, consisting of a 1200 horse-power direct-current motor, with two commutators, which enable the machine to be run on a 110 or 220-volt supply. The machine has a speed range of 150–1200 revolutions per minute, and the alternator can generate single, two or three-phase current at frequencies of from 15 to 120 cycles per second and at pressures of from 275 to 720 volts. The voltage range

is obtained by series-parallel arrangements of the windings, which can be altered at will by means of links on the terminal board. The voltage can, of course, be stepped up to any desired value by a bank of transformers. When working at the maximum speed of 1200 revolutions per minute, the maximum continuous three-phase output of the machine is 1200 kVA. The alternator is constructed in accordance with standard low-speed practice. The stator core has open slots. The rotor poles are laminated to reduce the electrical losses. As the alternator is to be used for accurate testing work, it has been designed to give a pure sine wave. Current for exciting the machine is derived from a separate direct-current supply. The set is reversible; that is to say, the alternator will run as a synchronous motor and the direct-current motor as a shunt or level compounded generator. A mechanical reduction gear exhibited is designed to transmit 520 brake horse-power, and gives a speed reduction of 9000 to 1500 revolutions per minute. Another exhibit is a steam jet ejector air pump for coupling to the surface condenser of an 800 brake horse-power steam turbine. There are also an oil-immersed three-phase core type transformer with disc coils, searchlight reflectors and examples of the company's steel turbine blades, &c.

Alloy Welding Processes, Ltd.

Hitherto it has been usual when welding with three-phase alternating current to draw the supply from one phase of the system, but by means of a welding equipment exhibited by Alloy Welding Processes, Ltd., of 14–16, Church-street, Islington, all three phases can be used at the arc. Two of the phases are connected to a twin electrode consisting of two rods insulated from one another, whilst the third phase is connected to the work, as shown in Fig. 14. This gives a rotating arc between the electrodes and the work, and only one phase gives zero current at any instant. Apart from the fact that the system balances the load on the mains, which is an advantage from the central station engineer's point of view, it has been found that the open circuit voltage can be considerably reduced, and that the power factor is greatly improved. It is said to be possible to strike and maintain the arc with an open circuit pressure as low as 35, whilst the voltage across the arc is only 25. Both from the points of view of safety and of the rate at which the metal can be deposited, the system is claimed to offer considerable advantages, because one operator can deposit twice as much metal in a given time as compared with an operator using a single electrode. It is stated, in fact, that one man can do the work that is normally done by two. The three-phase arc is also said to maintain a practically constant temperature, and to keep the gases

FIG. 14

in the space between the electrodes and the work in a state of permanent ionisation, thus increasing the conductivity of the arc and reducing the required voltage. The illustration, Fig. 15, shows the external appearance of one of these three-phase arc welding equipments with the front of the case opened. In order to prevent an arc being maintained between the rods forming the twin electrode a switch is provided, either on the electrode holder or the welding screen, for the purpose of extinguishing this arc. This switch is connected to a three-pole contactor, which, when opened, makes all the welding cables dead. It is said that the operator soon becomes accustomed to this device, and that he opens the switch at the same instant as he draws the electrodes away from the work.

Automatic and Electric Furnaces, Ltd.

The new Wild-Barfield carburising furnace shown in Fig. 16 is being exhibited by Automatic and Electric Furnaces, Ltd., of 173–175, Farringdon-road. The heating elements are totally enclosed in the refractory brick lining of the chamber, and all possibility of damage from contact with the soot and gases coming from the carburising compound is thus avoided. A totally enclosed brick element, as used

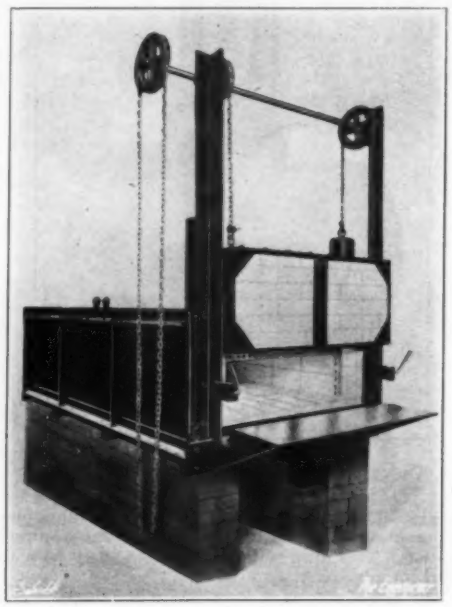


FIG. 16—WILD-BARFIELD CARBURISING FURNACE

in the construction of the furnace, is shown in Fig. 17. The heating element consists of spirals of high quality nickel-chromium wire, which extend throughout the length of the roof and sides of the furnace and they are connected to bus-bars at the back of the furnace where the heaters can easily be replaced when they have reached the end of their useful life. The furnace is fitted with the company's standard automatic temperature control gear, which consists of a pyrometer regulator connected to an automatic make-and-break switch. The regulator is fitted with an adjustable pointer, which is set at the temperature it is desired to maintain in the chamber, and when this temperature is reached and recorded on the regulator in the usual manner, the automatic switch breaks the heating circuit. The furnace temperature then commences to fall, but as soon as it has dropped to a fraction of a degree below the predetermined point, the controller re-makes the heating circuit, and the process is repeated. It is therefore possible to maintain constant temperatures for any length of time without attention.

Another exhibit is the Wild-Barfield high-speed steel-hardening equipment, which is a complete portable unit for the production hardening of high tungsten steel. It comprises a high-temperature chamber for hardening, a pre-heating chamber, a tray for preliminary warming, and a main switch and fuses, all mounted on an angle iron stand, to which an optical pyrometer can also be fitted. A new Wild-Barfield electro-magnetic hardening furnace

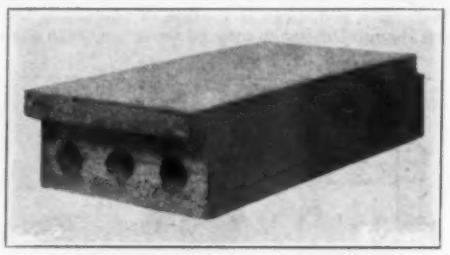


FIG. 17—WILD-BARFIELD HEATING ELEMENT

on the company's stand has an arched chamber, measuring 2ft. 7in. by 1ft. 8in. by 10in., and has been specially designed for the correct hardening of large gears, tools and wearing parts generally. The usual magnetic indicator gives the exact moment for quenching. Various electro-magnetic hardening furnaces are to be seen in operation, and the hardening of small tools, &c., such as taps and dies, is being demonstrated.

Electro-Mechanical Brake Company, Ltd.

Among the exhibits of the Electro-Mechanical Brake Company, Ltd., of Eagle Works, West Bromwich, is a lifeboat winch controller, with the company's self-contained "E.M.B." unbreakable jointless and rustless grid type resistance and suitable for mounting on the deck. The controller is constructed on very robust lines, and is specially designed for arduous duty.

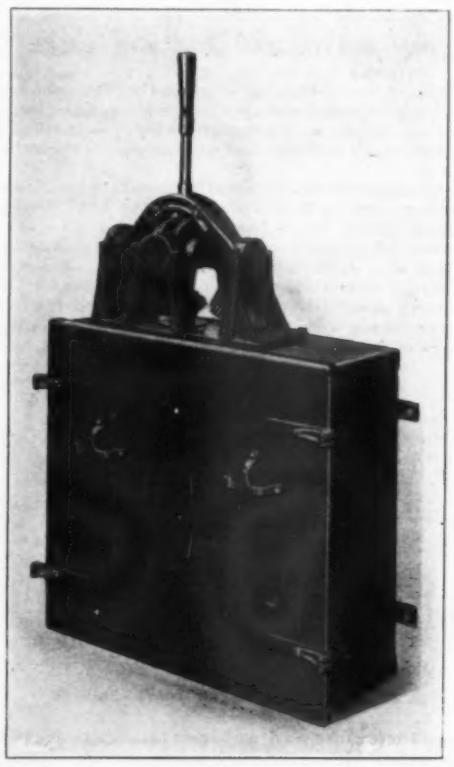


FIG. 18—E.M.B. TWIN-DRUM CONTROLLER

There is a cargo winch controller suitable for mounting on a ship's deck and a standard steel case controller suitable for mounting between decks. Another controller designed for mounting between decks is particularly suitable for controlling engine-room auxiliaries. Midget controllers for controlling motors for runways, telphers, hoists, &c., are shown. Other exhibits consist of a controller with vertical and horizontal operating gear, designed for crane service, the operating gear moving in the direction of the load, explosion-proof controllers designed for use in mines, gasworks, chemical works, &c., and controllers with two drums in one case, as shown in Figs. 18 and 19, the gear being arranged so that either or both drums can be operated together or separately. We should not omit to mention that the company is showing two of its new alternating-current and direct-current starters, which have recently been put upon the market. The special features of these starters are

FIG. 15—THREE-PHASE WELDING SET—ALLOY WELDING PROCESSES

a welded steel case, a drum with hinged fingers fitted with renewable tips, slow-motion step-by-step lever gear, and a separate draw-out pattern isolating chamber. The isolating chamber and main door are interlocked so that the isolating switch must be in the "off" position before the doors can be opened, and

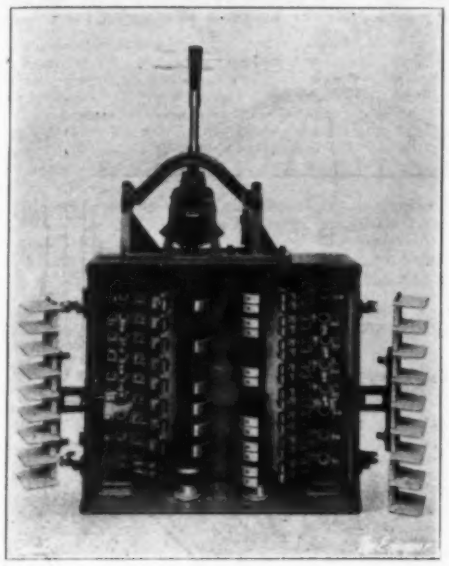


FIG. 19—E.M.B. TWIN-DRUM CONTROLLER

it is impossible to close the isolating switch unless the doors are properly closed.

C. A. VANDERVELL AND CO., LTD.

The most original exhibit on the stand of C. A. Vandervell and Co., Ltd., of Acton, W. 3, is an electric lighting appliance which can readily be attached to a life-buoy or other life-saving device. The appliance is made in the form shown in Fig. 20. At one end there is an electric light bulb, whilst in the main body there is a battery consisting of two "N I-F E" alkaline cells and at the other end, which becomes the bottom of the apparatus when it

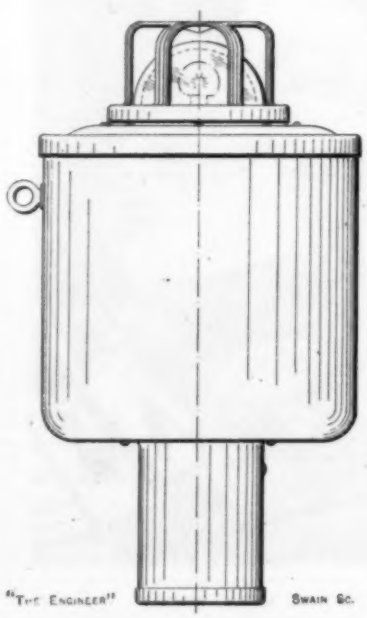


FIG. 20—LIFEBUOY LIGHT—VANDERVELL

is in use, there is a chamber containing a plunger. This part of the device is pierced so that when it is immersed in water the pressure of the water forces the plunger upwards, thereby bridging two contacts and completing the electrical circuit. The open guard which encloses the lamp can easily be detached, and on removing the lamp fitting, access can be gained to the battery. The whole apparatus is completely water-tight, and it floats with the lamp upwards immediately it reaches the water. As shown in the drawing Fig. 20, an eyelet is provided for attaching the appliance to a life-buoy or other life-saving device.

(To be continued.)

IT appears, from experience gained in the Borough of Brooklyn, New York, that if cast iron pipes 48in. in diameter by 1in. thick, are subjected to the external pressure of a sand fill more than 13ft. deep, they are liable to failure through longitudinal cracking.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RECENT BRITISH LOCOMOTIVES.

SIR,—Your correspondent Mr. W. B. Thompson again raises the question as to why the compound locomotive does not find favour in this country, and it would be most interesting, I am sure, to many of your readers if a satisfactory answer could be found to this question.

One of the chief difficulties in discussing this matter is that protagonists of the compound really refuse to discuss the matter at all, and boldly claim that compounding will give an increase in power of 50 per cent. or more under every condition whatsoever, and that it has not a fault in the world. I submit that this is not reasonable; all our locomotive engineers would not throw away these advantages for a mere fad.

In my humble opinion, the real drawback to the compound is its inability to develop a high tractive effort at slow speeds compared with a simple locomotive of like size, and in the case of many of our main lines, which have gradients of a two-figure severity interspersed in long stretches of easy going, it would mean using locomotives of a much larger size than is now customary. I know that the advocates of compounding claim that a compound can develop a M.E.P. referred to the H.P. cylinder of 1·43 times the boiler pressure; if that were so it is indeed difficult to understand why compounds are not universally used. However, if we examine the matter further it would seem that the above figure is not even approached and is, in fact, not theoretically possible. If we draw an ideal indicator diagram, assuming 225 lb. per square inch admission pressure, no wire-drawing, no compression, isothermal expansion, 5 lb. per square inch back pressure, 20 per cent. clearance in both cylinders, 75 per cent. cut-off in the high-pressure cylinders and a 2 to 1 cylinder ratio, we shall find that the total M.E.P. referred to the L.P. cylinder is about 146 lb., or 0·65 of the admission pressure, or 1·3 of the admission pressure referred to the H.P. cylinder; this could not be obtained in practice, as no allowance is made for rounding off the corners of the diagram or to receiver drop.

Again, if we look at the matter from road results, using the Deeley formula to obtain the rolling resistance, it will be found that the highest M.E.P. referred to the L.P. cylinder is in the order of 90 lb. As an example the *Railway Magazine** for May quotes a letter from Lord Monkswell giving a run on the French Northern Railway with one of the latest 4–6–2 locomotives with 581 tons behind the tender with a minimum speed of 40 m.p.h. up 1 in 125, the regulator being full open, the boiler pressure at blowing-off point, and the engine in full gear, the horse-power works out to 2090 and the M.E.P. referred to the L.P. cylinder is 91 lb.

If we assume that 100 lb. could be developed at a slower speed this gives the tractive effort as 21,600 lb., but if we now look at what tractive effort is required by the Great Western Railway locomotives on the Devon banks it will be seen that the "Castle" class engines are required to develop considerably more than this; the limit load for those engines is 288 tons and the steepest gradient 1 in 38, taking the weight of the engine with the smaller tender as 120 tons, the tractive effort for the gradient alone is 24,100 lb., and if a speed of 25 m.p.h. is assumed the extra for this is 2100 lb., a total of 26,200 lb. Now the "Castles" are much smaller engines than the latest "Nord" 4–6–2's, and if we take the new "King" class, which are more comparable in size, these with a limit load of 360 tons under the same conditions must develop a tractive effort of 31,750 lb. C. M. KEILLER.

Cookham Dean, September 5th.

SIR,—Our old friend W. B. Thompson, in his letter to you of the 26th ultimo, is, I think, unfair to the technical Press generally and THE ENGINEER in particular. It is clear that drawings and particulars of new designs cannot be published unless such be forthcoming from the C.M.E.s Reference to last November will point my meaning. In that month you were able to publish copious drawings and a lot of real information in respect of Mr. Maunsell's Lord Nelson, which is probably the most interesting locomotive of modern times.

Albeit, like your correspondent, I deplore the lack of information generally available and cannot understand the need or reason for so much secrecy.

The compound question, in view of recent developments, I believe, is likely to be revived. A. J. BREWER.

Surbiton, September 5th.

TRADE MARKS.

SIR,—The chief intention of the Merchandise Marks Act, 1926, which came into force on June 15th last, was to ensure that imported foreign goods sold in this country should bear an indication of origin, so that the purchaser would know whether the goods he was buying were of British or foreign manufacture. Section 1 of the Act provides that it shall not be lawful to sell or expose for sale any imported goods to which there is applied any name or trade mark of any manufacturer, dealer or trader, or the name of any place or district in the United Kingdom, unless the name or trade mark is accompanied by an indication of origin, and the name or trade mark shall be deemed to be applied to goods if it is applied either to the goods themselves or to some other thing in or with which the goods are sold or exposed for sale. The section is not to have effect in respect of the application of a name or trade mark to articles used or to be used as coverings, labels, reels or otherwise as articles in or with which goods manufactured or produced in the United Kingdom are sold or exposed for sale, if the name or mark applied is the name or trade mark of the manufacturer of, or of a dealer or trader in those goods in the United Kingdom and the name or mark was applied with his consent. Clearly it would be no offence under the Act for an English jam manufacturer, for instance, to buy his pots from Germany, put in his jam, and stick his label on the pot, or for a manufacturer of sewing cotton to buy his reels in France, wind on his cotton and put his label on the end of the reel, and in neither of these cases would it be necessary to mark the jam container or the cotton reel with an indication of origin.

The question that is exercising our minds therefore is as to whether an English motor car manufacturer, for instance, would be committing an offence if he purchased, say, lamps or tires or magnetos from abroad and fitted them to a car which contained in the usual place the trade name of the car or the trade mark or name of the manufacturer, and then sold the car, without indicating in a prominent position that the tires or lamps or magnetos were of foreign origin. The wording of the section is somewhat difficult to decipher, and it may be that in due course the assistance of the courts will be required before manufacturers or agents or dealers in this country will know exactly where they stand.

If a motor car or motor cycle manufacturer could import, say, 75 per cent. of the component parts of the car or motor cycle from abroad, assemble them in this country, and apply to the completed machine his name or trade mark without committing an offence under Sec. 1 of the Act, then it seems to us that the Act is likely to be to a great extent a dead letter. Surely it was the intention of the legislator in framing the Act to make such a thing an offence unless the indication of origin be clearly shown.

On the other hand, suppose the only foreign articles used in the construction of the car or motor cycle were the pistons or the gear wheels, which are hidden from the eye, is it necessary for the motor car or motor cycle manufacturer and the agent or dealer to see that before he sells or exposes for sale a car or motor cycle that an indication that the pistons or the gear wheels in the car are of foreign manufacture is clearly marked, so that a purchaser shall know that the article he is buying, although ostensibly British made throughout, may contain some parts of foreign origin. Where is the line to be drawn? We welcome the views of others on what seems to us to be rather an important matter, not only to manufacturers in this country, but agents, dealers, and the public generally.

RUDGE-WHITWORTH, LTD.,
Coventry, September 5th. JOHN PUGH.

THE FLETTNER RUDDER.

SIR,—From the report of the trials of the new ferry boat Marlowe we are asked to infer that owing to the efficient control accorded by the Flettner rudders, this vessel turned completely round in a circle but 42ft. greater in diameter than her own length of 158ft. It would be of interest to enquire what were the respective rates of revolution, and direction of same, in the case of both starboard and port sets of propulsive machinery during the manœuvre, as without this information the value of any test of rudder effect as such is completely negatived by the fact that the vessel is provided with twin screws.

S. P. CHRISTIE.

London, S.W. 7, September 5th.

SIXTY YEARS AGO.

THE year 1867 was a bad one for British industry. A financial panic had occurred, many firms had become bankrupt, and even some of our railways were in a parlous position. Enterprise was at a low ebb, for no one could be found to finance new undertakings. In our issue of September 6th, 1867, a brief paragraph gives us a picture of the shipbuilding industry on the Thames at that date. We recorded that the complete dearth of work continued. On the numberless slips between the steam boat pier at Millwall and the Victoria Docks there were not four vessels being built. Poles and scaffolds alone tenanted the ground except in two instances. At one yard, which we did not name, tubes for a pneumatic railway were being made, and at the Thames Ironworks a large ironclad designed by Mr. E. J. Reed was being built for the Prussian Government. It was evident, we said, that the shipbuilders on the Clyde had superlative natural advantages over those on the Thames. Iron and coal were both found close to the Scottish river, labour could be obtained at a cheaper rate, and the alleged superiority of London over Glasgow workmanship had become more fanciful than real. In these circumstances we experienced difficulty in persuading ourselves that the iron shipbuilding trade on the Thames could be resuscitated with profit to those concerned. The industry, however, did overcome its difficulties and the Thames continued for many years afterwards to be a centre of the trade. Eventually, however, it was driven away. The last vessel of any size constructed on the banks of the river was the Dreadnought battleship Thunderer, which was launched from the yard of the Thames Ironworks in 1911. . . . In the same issue we recorded the fact that Mr. John Brown, head of John Brown and Co., of Sheffield, had been knighted in consideration of the many public services which he had rendered to the country, the most prominent of which had been "the development of the clothing of our armour-clad fleet." Sir John Brown was born in 1807 and began his business in a small establishment in Furnival-street, Sheffield. In 1867 the Atlas Steel Works covered an area of more than 21 acres. All the extensions, we recorded, had been planned and carried out by Sir John Brown himself without the assistance of an architect, and the major portion of the machinery had been made at the works. Sir John was a pioneer in the introduction of rolled armour plate, and at the date on which we wrote nearly three-fourths of the British ironclads were armoured with plates made at his works.

FOSALSIL WORKS, COLCHESTER.—Yesterday (Thursday) the first unit of the Fosalsil works which have been erected at Colchester by Moler Products, Ltd., were opened in the presence of a gathering representative of various interests. "Fosalsil" is the name given to a natural diatomaceous material which, when made into bricks or blocks or when applied in the form of a cement, has a very high heat and sound-insulating capacity, and is remarkably fireproof. In the form of hollow blocks, it has a strength slightly greater than that of terra-cotta and a weight of only about two-thirds of that material. It is being used in the construction of buildings of many kinds and for various technical purposes, as in gasworks. The new works at Hythe, Colchester, include all the plant necessary for the manufacture of the bricks, blocks and insulating material, including separating plant, disintegrating plant, elevators, hoppers, mixing plant, brick and slab-making plant, drying kilns, burning kilns and stores.

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* See also THE ENGINEER, July 22nd, 1927.—ED. THE E.

Grooving Machine for Coned Wheels

In the practical production of the P.I.V.—positive infinitely variable—change-speed gear, one of the chief manufacturing problems to be overcome was to devise a satisfactory method of forming the teeth on the faces of the conical plates between which the self-pitching chain has to run. A full description of the P.I.V. gear and its method of operation appeared in our issue of August 27th, 1926, and from that account we reproduce in Fig. 1 a view of the gear, which will help to make clear the problem now to be discussed. The pulleys over which the chain passes are each formed of two members, which can be moved away from or towards each other, so as to allow the chain to move in towards a lesser or outwards towards a greater diameter and so produce the desired variation of the speed. The pulley members each consist of a cast iron backing to which is affixed a conical, case hardened face formed with radial teeth. The teeth on one member are directly opposite the gaps in its mate, with the result that the humps throw over the cross slats of the chain to the number required to fill the width of the hollows at the particular diameter at which the chain is riding.

The teeth on the conical face plates are radial towards the apex of the cone. They decrease in pitch from the outer circumference of the plate inwards after the manner of the teeth of a straight toothed bevel gear wheel. Unlike these teeth, however, they do not decrease in depth as the apex is approached, but preserve a constant height in order that the depth of engagement of the chain slats may be uniform at all settings of the chain. Unlike bevel gear teeth, too, the teeth of the P.I.V. face plates are formed not with involute or other curved form of flanks but with plane flanks sloped at 30 deg. away from the normal to the conical surface.

Various methods of machining the coned faces were tried when the manufacture of the gear was begun, but full satisfaction was not attained until the special system described below was evolved. The face plates are received in the form of conical pressed discs, about ¼in. thick and up to 12in. in diameter, their size depending upon the

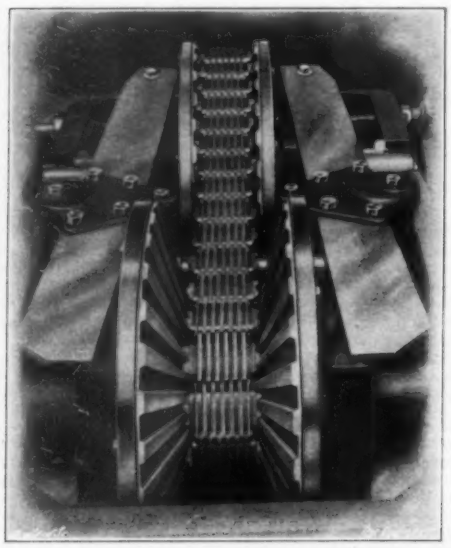


FIG. 1—P.I.V. CHANGE-SPEED GEAR

horse-power to be transmitted by the completed gear. The material is a tough case hardening steel. In all sizes of the gear up to the present maximum of 10 horse-power each face plate is formed with 60 teeth. After machining the discs are case hardened to an extent that enables them to scratch glass. The difficulty experienced in the early days of manufacture consisted of discovering a means of cutting the teeth that would ensure that the edges of the gaps were exactly radial and that would permit each gap to be cut in a single operation.

The discs as received are at the outset turned all over the object, being, so far as the concave face is concerned, to provide a good seating for the disc on its cast iron support, and in the case of the convex face to remove the scale and skin and so reduce the wear of the milling cutter by which the teeth are subsequently cut. The machined surface left on the convex side by the lathe would normally form the tops of the teeth. Actually, however, it suffers a further removal of metal during the teeth milling process. The object of this double cutting is to get well down below the original skin of the blanks, a procedure found to be very necessary if uniform case hardening is to be secured and distortion of the discs under the case hardening treatment is to be avoided.

The machine employed for cutting the teeth is a standard horizontal milling machine, to which has been added a specially designed magnetic chuck to which a reciprocating rotary movement can be given. In addition, the table carrying the chuck is given simultaneously a reciprocating translatory movement. The milling cutter is a disc about $^{7}/_{16}$in. thick, with cutting teeth of the profile shown at A, Fig. 2. The small ridge at the centre is about $^{1}/_{16}$in. high and about $^{1}/_{16}$in. thick at the middle of its height. Its edges slope at 30 deg. This ridge cuts the gaps between the teeth while the rest of the cutting edge takes the second cut referred to above on the tops of the teeth.

In the case of a face plate for a 10 horse-power equipment, the teeth are about 4in. in length. The gaps are as shown at B, Fig. 2, about $^{5}/_{16}$in. wide at the larger end and about $^{1}/_{16}$in. wide at the narrower. They are of a uniform depth of $^{1}/_{16}$in. throughout. The work is mounted on the table at such an angle that the bottom of the gap to be cut is horizontal, and is fed forward horizontally beneath the cutter. While it is being fed forward it is given a rapid rotary reciprocation about the conical axis, the reciprocation amounting to 1½ deg. on each side of the middle position. This reciprocation clearly causes the width of the gap to diminish progressively as the conical apex is approached.

The reciprocatory rotational movement would by itself be sufficient to give the desired result if the ridge on the cutter edge were of zero width. It is, as we have said, $^{1}/_{16}$in. wide, and consequently if the cut were continued to the apex of the cone—the cone not being truncated—the width of the gap at the apex would be $^{1}/_{16}$in. instead of zero as required if the flanks of the gap are to be truly radial from the apex. The width of the ridge on the cutter is in effect reduced to zero by causing the work to execute a translatory reciprocation of $^{1}/_{32}$in. on each side of the normal position, the translatory reciprocation being of the same frequency as the rotatory reciprocation but directly opposite in phase—C, Fig. 2. It should be obvious that this method of obtaining truly radial flanks is applicable only to truncated cones or to annuli, the inner diameter of which exceeds a certain limit. Applied to complete cones or complete discs the gaps would have radial flanks up to the point at which their width became $^{1}/_{16}$in. From that point onwards to the apex of the cone or the centre of the disc the width of the gaps, instead of diminishing to zero, would increase from $^{1}/_{16}$in. until they became ¼in. at the apex or centre. The degree to which the P.I.V. face plates are truncated is more than sufficient to avoid the limiting point.

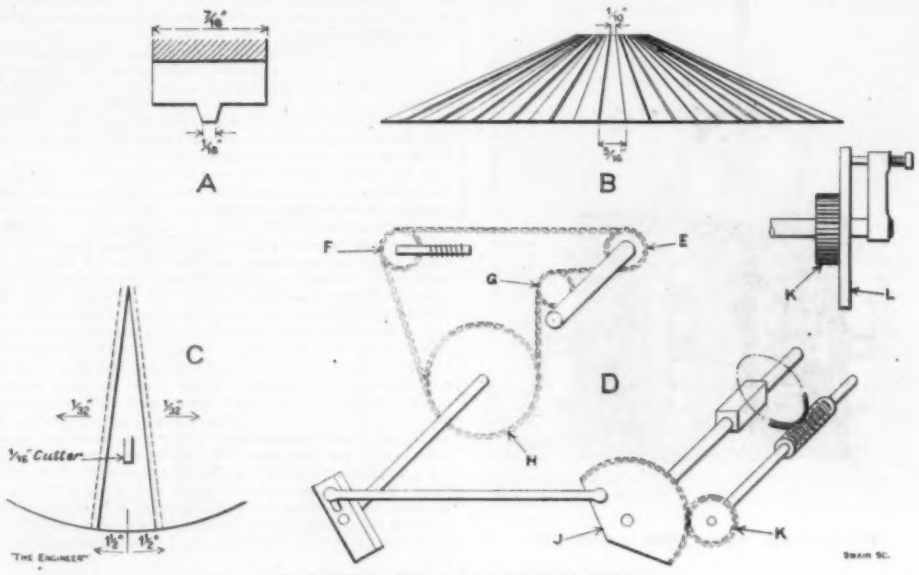


FIG. 2—CUTTER, WORK AND MACHINE DETAILS

The milling machine as adapted for the purpose of this process is illustrated in Fig. 3. The essential details of the added parts are indicated in the sketch D—Fig. 2. Power for the two reciprocatory movements is derived from a sprocket wheel E on the cutter spindle. It is transmitted by chain over two guiding sprockets F G to a large wheel H mounted on a shaft on the table. The sprocket F is acted upon by a spring which serves to preserve the tension of the chain when the table is moved horizontally. On the end of the shaft carrying the wheel H a balanced crank is fitted with an adjustable crank pin. From this pin a rod transmits reciprocating motion to a semi-circular toothed sector J, at the end of a shaft on which a square thread is cut. This thread engages with a bush connected with the cross slide on which the magnetic chuck is fixed. The thread and bush are relied upon to move the slide in one direction only. The return half of the reciprocation is effected by springs bearing against the edge of the slide. The object of the spring return is the elimination of lost motion caused by backlash between the screw and bush. The rotary reciprocation of the work is obtained from a pinion K meshing with the sector J. This pinion is mounted on a worm shaft which engages with a worm wheel attached to the base of the magnetic chuck. The pinion K is not directly connected to the worm shaft. It is fixed to a plate L, in which two holes are provided for the reception of a spring pressed pin carried by an arm fixed to the end of the worm shaft. This arrangement enables the worm shaft to be indexed forward through 180 deg. at a time, an amount corresponding to the pitch of the teeth to be cut on the face plates.

The adjustable crank at the end of the shaft carrying the large sprocket wheel enables the amount of reciprocation given to the sector J to be varied. This variation clearly affects simultaneously and proportionately the translatory and rotational reciprocations. A recent improvement consists of duplicating the crank and the connecting-rod in order that the two reciprocations may be adjusted separately.

FIG. 3—MILLING MACHINE ADAPTED FOR GROOVING CONED WHEELS

This machine is being shown by P.I.V. Chain Gears, Ltd., of 7, Princes-street, S.W. 1, on its stand at the Shipping, Engineering and Machinery Exhibition now open at Olympia.

THE unusual properties of iron and other metals which have been rendered passive by oxidising treatment have been attributed by many investigators to a protective film of oxide or other material. This explanation has been rejected by some chemists, since no film is usually visible, while iron which has been covered with a visible film by heating is often not passive. The presence of very thin films, too thin to give interference tints, has been proved by the work of U. R. Evans, which has been published in the May issue of the *Journal* of the Chemical Society. He has found it possible to render these films visible by dissolving away the metal below them by anodic treatment or by means of iodine. The envelope of the iron electrode after anodic treatment consisted of two thin transparent parallel membranes of ferric oxide united at the two edges. There seems to be little doubt that this film is the cause of passivity; where the film is broken or contains cracks the metal is active.

Railway Matters.

THE London, Midland and Scottish Company is giving names to its fifty new 4–6–0 express engines, the first of which was illustrated on page 154 of our issue of August 5th. That illustration did not show the name, but the accompanying letterpress gave it as Royal Scot. The next—No. 6101—will be Highland Chieftain.

Two further accidents have unfortunately occurred on the French railways, and in each case the driver was killed, but there were no serious injuries among the passengers. One happened to the Pyrenees-Cote d'Argent express, of five Pullman coaches, which apparently was wilfully derailed near Tours on the Paris-Orleans line, and the other to a Toulouse-Bordeaux train on the Midi, which ran into some buffer stops at Montauban, owing to the points being set wrongly.

THE death of the thirteenth passenger, as a result of the Sevenoaks disaster of the 24th ult., brings the number of deaths this year of passengers in train accidents to twenty-five—the other twelve having lost their lives at Hull on February 14th. The record for 1927 therefore exceeds that of any year since the disastrous year of 1915. In 1924, however, the number was twenty-four, of which five passengers lost their lives at Euston, five at Haymarket, Edinburgh, and fourteen at Lytham.

WE have from time to time mentioned that all the distant signals between Paddington and Reading are provided with ramps for electrically repeating in the cabs of locomotives the position of the signals. Furthermore, automatic train control is in operation on the engine, and by its means, should a "warning" signal be ignored, steam is automatically shut off. One hundred and sixty two engines are already equipped with the apparatus, and all new engines, as built, and all those rebuilt, are to be so furnished.

IN a circular letter to the staff Sir Josiah Stamp, the president of the London, Midland and Scottish Railway, urges that the representatives of the men on the local councils should discuss fully and frankly business questions with the officers of the company. The circular observes that "at every station there are men or women whose eyes and ears can properly be engaged in seeing and hearing how our trade may be retained and developed, and whose powers of speech can be employed in advocating the advantages of the services offered by the London, Midland and Scottish Railway."

THE goods train receipts of the four grouped companies up to the end of August showed that, compared with the corresponding period of 1925, the London, Midland and Scottish Railway had made an increase of £1,411,000; the London and North-Eastern, £1,996,000; the Great Western, £917,000; and the Southern, £74,000. The falling-off in the passenger traffic, however, brought the L.M.S. figure down to a decrease of £272,000 and the Southern to one of £339,000. Matters were, however, better on the L.N.E. and G.W., as the total was an increase of £848,000 on the former and of £414,000 on the latter.

THE recent death of Mr. W. H. Kemp, the station superintendent at King's Cross, London and North-Eastern Railway, calls for mention, inasmuch as Mr. Kemp began his railway career at the bottom of the ladder. He started, when sixteen years of age, as a porter at Wakefield, and became a ticket examiner and then an inspector. He came to King's Cross in 1906, when forty years of age, and it is good to read in the men's organ, the *Railway Review*, that "he was beloved by all under his control. He fully realised that he had not only a strict duty to perform for the company, but also a duty towards his staff. He had a great human feeling, particularly with men who had spent their lives in the service."

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first seven months of the present year was as follows, the corresponding figures for 1926 and 1925 being added in brackets:—Locomotives, £1,114,147 (£2,284,946, £1,922,498); rails, £1,545,452 (£1,208,619, £1,172,386); carriages, £1,932,725 (£1,495,181, £889,051); wagons, £1,410,844 (£1,988,851, £2,025,583); wheels and axles, £369,714 (£330,642, £353,929); tires and axles, £332,430 (£184,685, £254,895); chairs and metal sleepers, £742,032 (£593,376, £487,285); miscellaneous permanent way, £913,216 (£712,244, £781,382); total permanent way, £4,071,432 (£3,158,887, £3,139,779). The weight of the rails exported was 188,371 tons (153,124 tons, 123,036 tons), and of the chairs and metal sleepers 74,753 tons (61,484 tons, 42,603 tons). During the month of July last the value of the locomotives sent overseas was £270,343 and included:—Argentine, £107,097; India, £47,160; Australia, £1302. The value of the rails then shipped was £352,245, and included:—Argentine, £113,644; India, £65,116; Portuguese East Africa, £22,786; Chili, £17,195; Straits Settlements, £13,937; British West Africa, £9910; Australia, £9742; South Africa, £3689; and New Zealand, £2843.

THE Sevenoaks accident has evidently made the daily Press nervous. A return excursion train on the Southern Railway broke a coupling near Crewkerne on Friday last, and the news appeared in heavy type in the most prominent page of one of the leading papers, with the double caption, "Mishap on the Southern Railway," "Cornish Excursion Train Broken in Two." The account then said that the rear half of the train was soon brought to a standstill, and a few minutes later the front part was also stopped without serious consequences. Readers with railway knowledge would know that, the train being equipped with the vacuum automatic brake, the separation of the coaches would sever the brake pipes, and the vacuum being destroyed the brake would automatically be applied. It is not, however, the purpose of this note to pass any criticism on our contemporaries, but to raise the question of whether carriage couplings have been sufficiently strengthened of late to meet the greater strain put upon them by the more powerful engines now used. It is, in that connection, instructive to note that the Accident Returns for last year show that out of 8861 breakages of couplings, 2322, or more than one-quarter, were carriage couplings and in 1140 of the latter it was the draw bar or draw hook that failed.

Notes and Memoranda.

ACCORDING to final figures compiled by the American Bureau of Mines, the production of crude petroleum (oil brought to the surface) in the United States in 1926 amounted to 770,874,000 barrels, a new record figure. This represents an increase over 1925 of 7,131,000 barrels, or nearly 1 per cent. Of the total production 633,726,000 barrels, or 82 per cent., was classed as light oil. This indicates a slight increase in the proportion of light oil production of 1926 over 1925.

GREAT interest in the growing of flax is being manifest by the farmers of Northern Manchuria. More than 1000 acres were planted in 1926 and the flax obtained was of excellent quality. The planters were thus encouraged to devote even more acreage thereto for the coming season. The flax grown in this section will be used for making coarse linen for home consumption, and it is planned to manufacture grain bags, which are now imported in enormous quantities from India.

TWO free scholarships, covering respectively five years in chemical or civil engineering in l'Ecole Polytechnique of the University of Montreal and four years' tuition in l'Ecole des Hautes Etudes Commerciales of Montreal, are announced in a circular over the signature of Grant Hall, senior Vice-President of the Canadian Pacific Railway. The scholarships, which are the gift of the railway, are offered to apprentices and other employees enrolled on the permanent staff of the company and under twenty-one years of age, and to minor sons of employees.

THE opening paragraph of a short article in the *Journal* of the Engineers' Club of St. Louis reads as follows:—"There exists, on the part of those not intimately connected with the working of copper, a belief that the ancients had a method of hardening that metal, with which art we today are not familiar. The fact of the matter is that our present-day metallurgists not only understand how the ancients hardened their copper and bronze, but also know how to produce copper and bronze products that are even harder than those left to us and which represent the evidence of the so-called lost art of hardening copper."

THE explosion of a stop-valve on board a small coasting steamer is attributed officially to water hammer; but the cause is rather unusual. Water appears to have collected in that portion of the range which, when the vessel was listed to starboard, was lowest. When the vessel, later on, became upright, this body of cold water moved, exposing its surface to the steam, the resulting water hammer causing fracture of the stop valve. It would be almost impossible to foresee such changes of conditions and their possible results so that the necessary action could be taken in time, but the provision of automatic drainage arrangements would probably meet the case.

IN sending out a circular concerning an inquiry from the South African Railways, for "spark arrester plates," the Comptroller-General, Department of Overseas Trade, makes the following remarks:—"It should be noted that the drawing referred to is not available in this department, and the information, therefore, is only sent to you as an indication of the kind of business offering in South Africa. In any case local representation is essential, and should you not be represented in the Union, but be desirous of quoting for such inquiries in the future, the department will be pleased to endeavour to put you in touch with suitable firms."

THE quantity of gas made in Great Britain during 1926 was 296,082 million cubic feet. This was 4·3 per cent. in excess of that made in 1925, which again exceeded that made in 1924 by 3·1 per cent. The increase in 1926 was entirely due to the increased make of water gas, a rather smaller quantity of coal gas being made in 1926 than in 1925. Only 16,564,000 tons of coal were carbonised in 1926, as compared with 17,031,000 tons in 1925; but 1,436,000 tons of coke for water gas, and 97,703,000 gallons of oil were used in the past year, as against 1,153,000 tons and 61,383,000 gallons in 1925. The residual products in 1926 included 11,177,000 tons of coke and breeze, and 187,546,000 gallons of tar, showing reductions of 221,000 tons and 6,613,000 gallons as compared with 1925.

THE construction of the Book Tower in Detroit, which will rise to a height of 873ft. above the ground, and will be the tallest building in the world, was started recently. The new building will have eighty-five floors, four of which will be underground, which will give it twenty-three floors more than the Woolworth Building in New York City, at present the world's highest building. The structure will have a 225ft. frontage on State-street, 120ft. on Washington Boulevard, and 180ft. on Park-place. The main building will rise forty-two storeys above the street, each floor containing 230,000 square feet of space. Above the building proper the tower will rise 120ft. by 125ft. The construction work will be of steel and concrete, and the exterior will be of marble and granite combined with light buff brick.

A TRAGIC story is recounted in the official report on the explosion of a stop-valve on board a British steamer whilst in American waters. All was going well when the chief engineer entered the engine-room and had just reached the foot of the ladder when the explosion occurred. There was no previous warning or sound of water hammer shock, merely one blow and a roar of escaping steam. The auxiliary engines stopped, the electric lights went out and the engine-room was enveloped in darkness. The chief engineer immediately closed the valves to the oil units, and assisted by the fourth engineer, eased the safety valves fully on the two working boilers. It was impossible to enter the stokehold. All the stokehold covering plates and ventilators were then opened to allow the steam to escape, as soon as possible, but it was some time before the stop-valves on the port and centre boilers could be closed. The bodies of the second and third engineers were then found below the stokehold plates. So intense had been the heat that the bitumastic covering on the tank top had melted, and death to the unfortunate men must have been almost instantaneous. Three firemen who were in the stokehold at the time escaped by seeking shelter in the empty port side bunker pocket. The explosion is attributed to water hammer.

Miscellanea.

AN automatic telephone exchange is to be installed in Doncaster in 1930.

A SEAM of coal, 14ft. thick, has been discovered at Cultus Lake, near Chilliwack, British Columbia.

IT is proposed to put up a beet sugar factory, capable of dealing with 100,000 tons of beet a year, at Penkridge, Staffs.

TUNGSTEN ore in payable quantities is said to have been discovered at the Riverside Mine, Stewart, British Columbia.

A GEOLOGICAL survey of Saskatchewan's mineral wealth is being made by Professor J. S. De Lury, of Manitoba University.

IT is proposed to establish a large cement factory near the Blue John and Speedwell Mines, at Castletown, Derbyshire.

IT is proposed to hold a Fuel Conference at the Imperial Institute, London, from September 24th, to October 6th, next year.

THE Vancouver Ironworks, Ltd., have just completed a new shop for the manufacture of boilers, tanks, stacks and other steel plate work.

AN experiment is being made in Jasper Park, Alberta, in the surfacing of roads with the natural bituminous sands found in the northern part of the province.

THE output of asbestos and allied products in Canada during last year was valued at 1,530,094 dollars, representing an increase of 14 per cent. over 1925.

TWO of the large china clay businesses of St. Stephen's, near St. Austell, Cornwall, have been bought by the Papermakers' Importing Company of America.

THE steel works of J. Spencer and Sons, Ltd., Newburn, near Newcastle-on-Tyne, are being dismantled, but the buildings may be used eventually for some other industry.

IT is said that the tunnel between Windsor, Ontario, and Detroit, will probably be finished by the middle of 1929. It is to be 31ft. in diameter, with a roadway 24ft. wide.

DURING the past year the output of explosives, ammunition, &c., in Canada, was valued at 12,155,220 dollars. The capital involved in the industries is estimated at some 16,800,000 dollars.

IT is claimed that the wireless station which is being put up by the Japanese Wireless Telegraph Company will be the largest of its kind in the world. It will probably be ready for work about the middle of next year.

A LARGE international industrial exhibition is to be held in Turin next year. Full information can be obtained from British firms interested by application to the Comitato pel Espozizoni, 24, Via Carlo Alberta, Torino, Italy.

THE New South Wales State Government has decided to make £120,000 available at once as part of the cost of the construction of the bridge over the Clarence River at Grafton. The bridge will coast altogether £500,000.

IT is announced that a factory for the production of asbestos-cement building materials is to be put up in South Africa by Bell's United Asbestos Company, Ltd., while the same company is arranging for the manufacture of high-pressure asbestos cement pipes.

THE Bridge Mechanical Scholarships, two of £50 a year for three years and one of £20 a year for three years, presented by Mr. Bridge, metal merchant, of Accrington, have been awarded to two day students of the Grammar School and to one of the Technical School.

THE production of phosphorus by Liljenroth electric furnaces operating at Piesteritz (Central German Nitrogen Works) now amounts, according to the *Chemical Trade Journal*, to 70 tons daily. The output is transported to Wolfen, near Bitterfeld, where it is oxidised to phosphoric acid.

THE new shaft of the Bolsover Colliery Company at Edwinstowe, Nottinghamshire, is down 250 yards, about half-way to the coal measures. It has passed the water-bearing strata. It is hoped to finish the shaft by the end of next May, and ultimately to attain an output of 4000 tons a day.

AN important bridge which has just been opened at Port Augusta (South Australia) over the upper waters of Spencer's Gulf provides another means of getting from Adelaide to the west of the continent. The new bridge is 1000ft. in length, and is supported on timber piles. Its width is 32ft.

CHROMIUM plating has, according to the *Chemical Trade Journal*, been revived in Sheffield, and makers of spoons and forks are using the process with success. The chromium plating works are busily employed, not only on the plating of spoons and forks, but motor car and bath and lavatory fittings.

EXTENSIVE developments are projected by the South Staffordshire Mond Gas Company, Dudley Port, which have recently been granted parliamentary powers under which it will be able to undertake new operations in the Black Country, involving a big extension of the present works at Dudley Port.

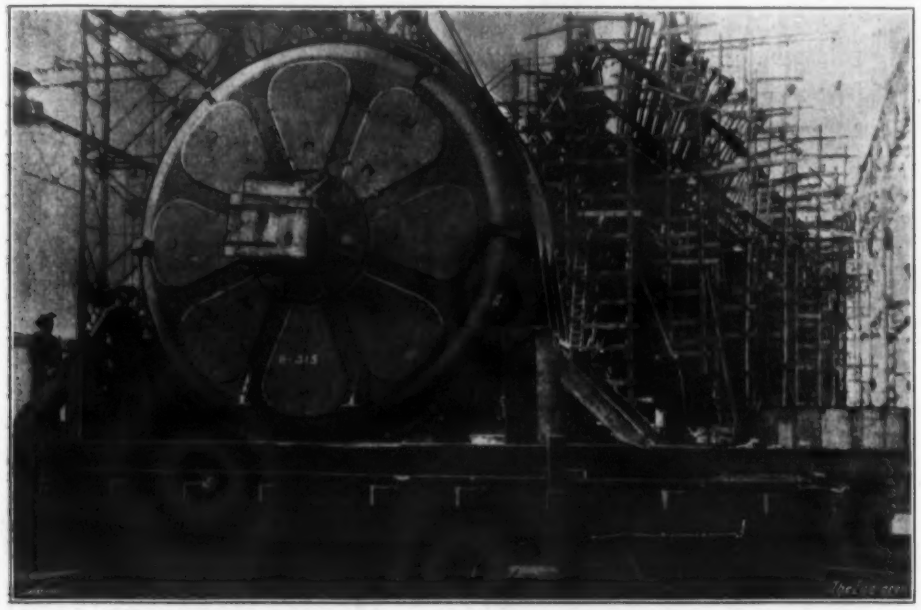
IMPORTANT reclamation and improvement works are to be carried out at the port of Havana, which will provide 117,000 m. of additional land of great potential value for building purposes. Already 80,000 m. have been sold at prices averaging 150 pesos (£30) per metre. A wide esplanade along the bay, estimated to cost 3,000,000 pesos (£600,000) forms part of the projected scheme.

THE Moji-Shimonoseki Straits railway tunnel, construction of which was delayed by the earthquake in Japan, is, according to the *Far Eastern Review*, to be constructed in 1928 by the Japanese Government. The tunnel will do away with the ferry service connecting Kyusha and points in Honshu, which often is interrupted for twenty-four hours at a time by storms. The bore will cost 10,000,000 dollars, and 3000 men will be engaged on the work.

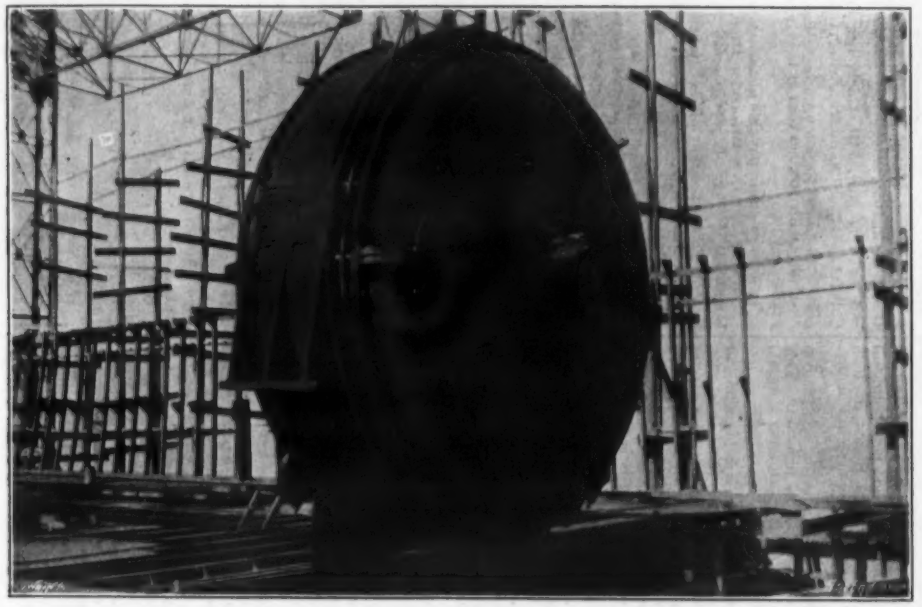
PANAMA PACIFIC LINER CALIFORNIA—PROPELLING MOTORS

THE GENERAL ELECTRIC COMPANY, SCHENECTADY, N.Y., ENGINEERS

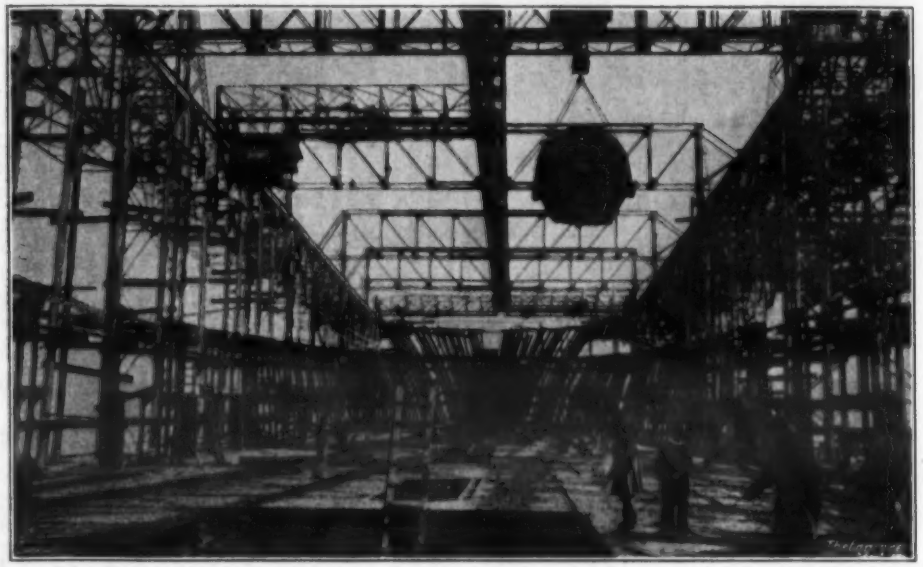
(*For description see page 285*)



MOTOR ON RAILWAY TRUCK ALONGSIDE BERTH



MOTOR READY FOR LOWERING INTO ENGINE-ROOM



DECK VIEW ALONG PARTLY COMPLETED SHIP

MAIN PROPELLING MOTORS IN POSITION

The Engineer

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DEATH.

At "Brooksby," Uppingham-road, Leicester, on August 23rd, Mr. A. A. JONES, Managing Director of A. A. Jones and Shipman, Ltd., age fifty-six.

THE ENGINEER.

SEPTEMBER 9, 1927.

The Mechanisation of Life.

HALF-A-CENTURY or so ago the mere threat of a strike on the railways was sufficient to arouse a feeling of trepidation, if not of panic, in the breasts of our populace. In the spring of 1867, for example, what was known as "the engine drivers' movement," a demand for a ten-hours day and improved remuneration, opened up the possibility, for the first time, of a cessation of work that would affect more than a section of the population. It was realised that if a fully effective strike took place it would mean the total arrest of nearly all the operations of trade and commerce. The country, to quote our own words of the time, would fall into a state of syncope. The stagnation of traffic on the railways would stop the flow of the nation's life blood. London and other large towns would, of a surety, be reduced to starvation as certainly as if they were surrounded by the strongest army that ever beleaguered a city. Fortunately for our fathers, the strike never became general among the drivers and firemen, but had it done so and had it been continued for more than a few days there is little doubt that our fears would have been found not to have been greatly or at all exaggerated. The present generation has experienced several widespread strikes on the railways, and last year successfully passed through a crisis of a much more general and a much more threatening character. To-day another railway strike, even another general strike, would not arouse the alarm which prevailed in 1867. It would prove a tribulation to trade, but the majority of the population would undergo its inconveniences without serious depression or grave fear of a calamitous outcome. Side by side with a growth in the complexity of our everyday lives, in our interdependence on one another for our daily wants, there has been a definite movement in a contrary direction, a movement creating alternatives in all things and making each individual less and less essential to the general welfare. There are many who express a dread that progress in the application of scientific discovery will—and that soon—result in the restriction of our lives and habits to a narrow round. As we see it, the possibility of such an occurrence was greater sixty years ago than it is to-day. With each advance the mechanisation of life may be increased, but simultaneously our dependence upon particular forms of mechanism becomes less.

Our fathers rightly feared the effects of a general railway strike in the spring of 1867. The mechanisation of life had reached a dangerous stage. It had taken away the old and, for its time, the efficient means of transport on which the industrial development of the country had been begun and had replaced it by a mechanical system of incomparably greater efficiency and economy. Nurtured by the railways, trade and population had blossomed to an extent which would have meant speedy and almost indescribable disaster if a return to earlier methods of transport had been forced upon the country. In those days there was no alternative between the railways and starvation. Steam traction on the roads was just beginning to be heard of as a practical form of transport, but it was still subject to many grievous legal and mechanical difficulties. Several decades had yet to pass before the mechanisation of life gave us a development of road transport able to rival and fit to serve as a substitute for the railways. In the chapter now being written we see science busily engaged giving us in the aeroplane a fresh alternative. The general strike of last year was defeated of its worst object, not because the men of 1926 had more courage or more resource than their fathers and grandfathers, but because progress in the mechanisation of life had placed in their hands, or laid ready to them, alternative means of conducting the essential services of the community. It is not only in the large affairs of life, but equally in the nominally small details which compose it, that we see this influence at work. Those who wish may bewail the fact that the modern housewife is no skilled dispenser of simples, and has largely lost or is rapidly losing the ability to prepare and cook her family's food. Old-fashioned remedies may be lost secrets, the tin opener may have replaced the roasting jack, air-tight packets of breakfast foods may have provided a means of escape from the high art of making porridge. But for each forgotten febrifuge or unguent the mechanisation of life has given us a score of patent medicines from which to select, and in the matter of foods and cordials has brought to our doors supplies which make us quite independent of the butcher and brewer. Each year science is providing us with new foodstuffs and new methods for the cure of disease, and is enlarging not restricting the number of alternative sources on which we may rely. No longer are we compelled to build our houses of bricks and mortar. Science has given us alternative materials in cement-asbestos, concrete and cast iron and in so doing has provided us with means of avoiding the tyranny of the bricklayer. We are not helpless if the shoemaker for any reason refuses to execute our order ; the rubber industry is at hand for our immediate aid. Half-a-century ago a universal miners' strike would have forced most industries quickly to close down and have wrought dismay in our kitchens. The eight months' cessation of production last year was surmounted because science had given us gas and oil as alternative fuels and because the increased mechanisation of life had rendered it commercially practicable for this country to draw its coal supplies from overseas. In luxuries, as in essentials, modern developments in the mechanisation of life are freeing us from, not binding us to, the rule of monopolistic sections. The silk growers of France, the very silkworms themselves, might to-day cease their labours for any length of time without seriously affecting the supply of silk-like fabrics. And if all the vegetable dyes in the world were withdrawn beyond our reach these same fabrics would go forth dyed with mineral hues of undiminished brilliancy and variety.

Science, as it affects human progress, is neither essentially beneficent, as some boast, nor essentially malignant as some fear, but is coldly neutral. If it sets up an evil it generally at the same time creates a benefit. It has given us an unparalleled means for the destruction of life and property and almost in the same breath has given us a means of augmenting the fertility of the soil and thereby

of increasing the ease of existence. The wounds which it places in our power to inflict are not more terrible than the wounds which it enables us to heal. In one test tube it leaves a virulent poison gas; in the next it deposits a merciful anæsthetic. Looking forward, we can view calmly a still farther increase in the mechanisation of life. We feel assured that the dread of such increase expressed by some, the fear that our lives will be wholly machine-ruled in a narrow, hard setting, is unwarranted. At one period of the mechanical age that fear might have seemed to be justified. Science, we hold, has now shown that, while it binds us to the machine, it does not bind the machine to a single path, but is constantly at work providing new roads for it. We have placed ourselves under its domination. Its immense power over our lives has been accumulated slowly and almost silently, and we cannot now escape from its rule, even for a "holiday" period of ten years, as the Bishop of Ripon would have it. But its influence is not wholly sinister. If it forces our lives into grooves, it sees to it that several are provided for alternative use lest one should become choked. If it restricts our independence and deprives us of our self-sufficiency, it releases us from dependence on particular individuals and removes the danger of dictation which the knowledge of such dependence must engender.

The Blast Pipe.

THE blast pipe is such an obvious means to an end that its virtues are never questioned. It is accepted as a detail of locomotive design which may be modified and studied, but never replaced. The exhaust has to be got rid of, and what better way can be thought of than to turn it to the necessary purpose of blowing the fire? Ever since the accidental discovery of its merits by Trevithick and its subsequent development by Hackworth, Stephenson, and others, it has remained a part of the locomotive which the engineer would no more think of omitting than he would consider leaving out the cylinders or the regulator. Air must be drawn through the fire, the hot gases must be induced to pass through the narrow tubes, the exhaust must be got rid of. These things fit admirably together. The invention was a brilliant one, for it applied an inevitable event to an essential purpose. Since the exhaust must be turned into the air, it is better to make use of it, than to expend the live energy of the boiler steam upon the operation of some other kind of blower.

Of the soundness of these arguments there can be no manner of question, yet circumstances are beginning to arise which make the position of the blast pipe less secure than it was. Amongst these circumstances the three-cylinder engine, and the four-cylinder engine with the crank arrangement which Mr. Maunsell has adopted, must be put in the first place. They have shown the unsuspected advantages which accrue from increasing the number of blasts per minute. The six evenly spaced blasts of Mr. Gresley's engines are better than the four blasts of normal two or four-cylinder engines; the eight equal blasts of Mr. Maunsell's engines are still better. But even the eight blasts have a cyclic variation, and, *a priori*, a perfectly even draught, that is, one with no blasts at all, would be better still. Draughts of the kind are in use on turbine locomotives, but unfortunately no figures as to their value have been published. The blast pipe absorbs a certain amount of horse-power by increasing the back pressure. Is the consumption in any degree comparable with the power absorbed by the little turbines which drive the fans of turbine locomotives? The upkeep of blast pipes is well-nigh negligible. What do the total charges which have to be set against the turbine and its fan amount to? Such questions as these would have to be answered before it could be said that the improvements in steam raising and coal consumption which are effected by the smooth draught are really economical. But here another interesting problem arises. In very general terms, it may be said that if an attempt be made to run a locomotive with less than 12 to 15 per cent. admission, the fire will come out of the door—there will not be sufficient blast to draw the flames through the tubes, and the whole internal economy of the boiler will be upset. It will not steam and the advantage of the short cut-off will be nullified. It may be said that no one ever wants to run with such long expansion in a single cylinder. Are we quite sure? No one has been able to run with such a short cut-off hitherto; neither the valve gear nor the blast would let them, and that *may* be the reason why it is considered unnecessary. But many a driver has at times partly to close his regulator because he cannot notch up close enough, and that is a practice which all engineers deprecate. As far as the valve gear is concerned, the coming of poppet valves—and that they will come is as certain as to-morrow's sun—will remove the obstacle. Captain Beames tells us that with the Caprotti gear on the Claughton engine he has successfully cut-off at very much less than 12 per cent.; at, indeed, such a trifling amount—a few per cent.—that it is outside practical consideration. Hence he can with that gear readily cut off at 10 to 15 per cent. But what, then, happens to the blast? Owing to the great freedom of the exhaust that results from the use of independent valves, his exhaust is no doubt better than the wire-drawn exhaust of slide or piston valves. We should be glad to know if it is sufficient, say, at 10 per cent. cut-off, to produce the necessary draught without resort to the steam blast. If it is, then, if he could modify the crank arrangement of the Claughton to the crank arrangement of the Lord Nelson, he should have an engine combining all the advantages of the Maunsell blast with those of the poppet valve gear. If, on the other hand, his draught is insufficient with a short cut-off he must sacrifice some of the flexibility which the gear offers, and it will be time to consider whether the adoption of other means of urging the fire might not be adopted with economy.

For many a year the locomotive was the simplest of all steam plants. It was not encumbered by those additions to its primitive simplicity that were to be found in stationary plants. It knew not condensers, governors, feed heaters, air pumps, lubricating pumps, and so on. Locomotive engineers have always stoutly maintained, and for long with a great deal of justice, that, in view of the peculiar services which a locomotive has to perform, simplicity was more essential than high efficiency. They were justified in that view by maintenance costs. But the pressure of events has been too much for them. Step by step they have had to surrender something of the early simplicity and add details which augment the efficiency. On the whole, the gain is greater than the loss. Maintenance charges are higher, but coal is saved, water is economised, and a higher traffic density on the lines is attained. We are convinced that the next step will be the extended use of poppet valves, and if, to take full advantage of that gear, the blast pipe has to go, or if for other reasons it is found advantageous to employ a steady, in place of an intermittent draught, we are sure locomotive engineers will not long hesitate to adopt it, even though it does mean a further addition to a machine which is already becoming heavily burdened.

The British Steel Trade and Its Bounty Scheme.

By JOHN W. HALL, M. Inst. C.E., M.I. Mech. E.

ON page 245 of last week's issue of THE ENGINEER reference was made to the fact that the leading British makers of steel for constructional purposes had offered a substantial bonus to those users of such material in the United Kingdom who would agree to purchase exclusively from them. A short summary of the terms of this offer was also given. The avowed object of the steel makers is to exclude foreign manufactured steel, and so to retain the home market for themselves. A somewhat similar arrangement, though on a less ambitious scale, was in operation before the war, and it had been known for some time that some such scheme was under consideration again, though its appearance at the moment, and in its present form, has taken many people by surprise.

Those who have not some knowledge of the details of running a large modern steel plant may naturally ask how an industry, which notoriously is working at a loss, can hope to better its position by reducing its selling prices. The explanation is that though modern appliances can produce steel with remarkable economy of fuel and labour, the plant is so costly that capital charges become extravagantly high unless the plant is kept in full and continuous operation.

The first stage in the manufacture of steel is that of making the smelting coke required to produce the pig iron. In round figures, 1½ tons of coal are consumed in making a ton of coke, and from modern coke ovens there is given off during the operation gas which, if burnt in the steel works, will provide as much heat as ¼ ton of coal, besides furnishing valuable by-products. Nearly a ton of coke is required to produce a ton of pig iron, and from the blast-furnace, after heating the blast and providing the power required for blowing, there often remains gas for driving the rolling mills, equivalent to the combustion of a quarter ton of coal, while the molten iron contains as much heat as would require the expenditure of another quarter ton to replace it, were the molten iron allowed to cool before being charged into the open-hearth furnaces, or into cupolas for use in the Bessemer vessels.

Thirty years ago these sources of heat and these valuable by-products were usually allowed to pass to waste, but with coal at its present high price this waste is no longer tolerable, and the coke ovens, blast-furnaces, melting shops and rolling mills must be organised as one undertaking. Only an aggregation of plant of this kind can be considered as a complete unit for steel-making purposes. With such an aggregation it becomes practicable to run the steel works with little, if any, more coal than is charged into the coke ovens.

Such a plant, however, absorbs a total capital of something like £10 for each ton of steel it can produce per annum—the capital in some cases is known to amount to nearer £15. Past experience proves that all steel works, if they are to keep up to date, must be entirely reconstructed about every twenty-five years. Hence the provision of ample financial reserves is a necessity. An allowance of 15 per cent. on the capital, or 30s. per ton of full capacity per annum, to cover depreciation reconstruction and interest, is by no means excessive. It is easy to see what a serious tax this becomes when the works are only partially employed, to say nothing of having to spread rates, taxes, salaries and other fixed charges over a reduced output. The only chance for producing cheaply is to keep the plant running at its full output the whole time.

The position of the British steel maker, which was becoming difficult before the war, has been rendered by it exceedingly serious. Fully to understand the position, it is necessary to consider the earlier as well as the later details of steel making, and how conditions have lately changed to the detriment of this country.

When Bessemer introduced his process for making steel on a wholesale scale, he discovered that he must use only pig iron sufficiently low in phosphorus to ensure that the phosphorus in the finished steel should be below 0·06 per cent. This practically limited the pig iron available to that containing not more than 0·045 P. The only ores in Europe obtainable in sufficient quantities and at a low enough cost which could produce pig iron fulfilling this requirement were the hematites in Cumberland or in Spain, whence they could be cheaply imported into South Wales and the East Coast of England. South Wales, Durham and Yorkshire possessed excellent coal for making the requisite coke for smelting these ores, and coal suitable for reheating the steel ingots. The acid Bessemer and acid open-hearth processes of steel-making therefore took firm root in this country and there appeared little probability that the continental steel makers, who had either to import the hematite pig ready made or the ore and frequently the coke, wherewith to make the pig, could compete seriously with the British maker in outside markets, while to undersell him in his own would have seemed beyond the bounds of possibility.

But two young chemists, Thomas and Gilchrist, reasoned that if they could keep the slag sufficiently basic, the phosphorus in the pig ought to pass into the slag, in which case it would be possible to use for steel making the phosphoric ores found everywhere, which were much cheaper than hematites. By adding enough lime, it was possible to keep the slag fairly basic, but the lime ate away the siliceous lining of the converter. Eventually they succeeded in forming a basic lining with burnt dolomite, held together by gas tar; by continuing the blowing after the carbon had been burnt, they found that the phosphorus did pass from the molten metal into the slag. But, as Bessemer had discovered, all blown metal is quite rotten, and red-short until deoxidised by the addition of an alloy of manganese; the spiegel or ferro-manganese available for this purpose contained much carbon, the addition of which to the bath of blown metal caused some of the phosphorus to pass back from the slag into the bath, which had, therefore, to be almost entirely free from phosphorus before the final additions of spiegel were made.

The new process required much more skill to work than did the old one. In the original acid Bessemer process, directly the carbon was burnt, the flame dropped in a characteristically marked manner readily recognisable, and all that was needed was to turn down the vessel and add "the finals." In the basic Bessemer process the drop of the flame is less easily recognised, and from it must be dated the duration of the "after blow" needed to remove the phosphorus, which does not begin to go until practically all the carbon has disappeared. If the pig contains 3 per cent., and the blown metal is to contain only 0·03 per cent. P, so as to make sure that after the addition of the finals the finished steel shall not contain more than 0·07 per cent., the after blow must last long enough to remove 99 per cent. of this dangerous impurity. But it must not continue so long as to over-oxidise the bath, or more ferro will be required to restore it, and this will introduce more carbon, and bring back more phosphorus from the slag. Hence the blower is between the devil and the deep sea. The after-blow only lasts about three minutes, so that the workman must be extremely accurate—it is a question of only a few seconds—and unless the pig is exceedingly regular in composition, the workman's